SECTION 5.0 - AFFECTED ENVIRONMENT

5.0 AFFECTED ENVIRONMENT

This section of the DEIR describes the environmental and human resource characteristics of the proposed preferred aquatic disposal sites. Documentation of existing conditions provides a baseline against which the impacts of the two proposed preferred aquatic disposal alternatives, described in Section 4, can be analyzed. Potential impacts will be discussed further in Section 6. The preferred disposal sites are:

1. New Bedford Channel - Inner CAD/OD
2. Popes Island North CAD

In this section, the environmental and human aspects of these sites are characterized and their surroundings are described.

5.1 Location and Hydrography

New Bedford/Fairhaven Harbor is located on the northern shore of the Buzzards Bay coast and borders the communities of Fairhaven to the east, and New Bedford to the west (Figure 5-1). It is approximately 56 miles south of Boston and 11 miles east of Fall River, Massachusetts. New Bedford/Fairhaven Harbor is a coastal embayment with a mean tidal range of approximately 3.3 feet or 1 meter (Howes and Goehringer, 1996). The Acushnet River is the most significant freshwater inflow to the harbor. It forms the border between New Bedford to the west and Fairhaven to the east. Other smaller tidal streams fed by fresh water intermittent and perennial tributaries drain into either the Acushnet River or New Bedford/Fairhaven Harbor.

The limit of the harbor lies at an imaginary line which extends from Clark's Point in New Bedford, east to Wilbur Point in Fairhaven (Figure 5-2). New Bedford/Fairhaven Harbor is divided into three separate regions: the Upper Harbor, the Lower Harbor (together referred to as the Inner Harbor) and the Outer Harbor. There are also distinct smaller coves and embayments around its perimeter. Beginning from the mouth of the Harbor and proceeding upstream, the following distinct regions of the harbor are delineated: The Outer Harbor region extends from the harbor mouth, north (upstream) to the hurricane barrier seawall that extends from Fort Phoenix Beach in Fairhaven west to New Bedford, just south of Palmer Island. From the seawall north to the I-195 Bridge lies the Lower harbor segment. From I-195 Bridge upstream lies the Upper Harbor segment.

Distinct areas of the harbor include the following: Proceeding north from the mouth of the harbor along the western shore lies the community of Clark's Point. North of the seawall along the western shore of the Acushnet River lie commercial wharves within the City of New Bedford. Some of the more notable wharves (proceeding from north to south) include the New Bedford Gas and Edison Light Company wharf, Homer's Wharf , the State Pier, Pier 3, and Pier 4. Continuing upstream (north), Fish Island lies under Route 6 and the New Bedford/Fairhaven Bridge in the Lower Harbor. To the east of Fish Island lies Popes Island Marine Park which also lies beneath the New Bedford/Fairhaven Bridge. Continuing clockwise, and proceeding south along the eastern shore of the Acushnet River lies, first, Delano Wharf, then Kelly, Union, and Railroad wharves, north of the seawall. Just east of the seawall on the eastern side of the southern limits of the Lower Harbor in Fairhaven lies the Fort Phoenix Beach State Reservation.

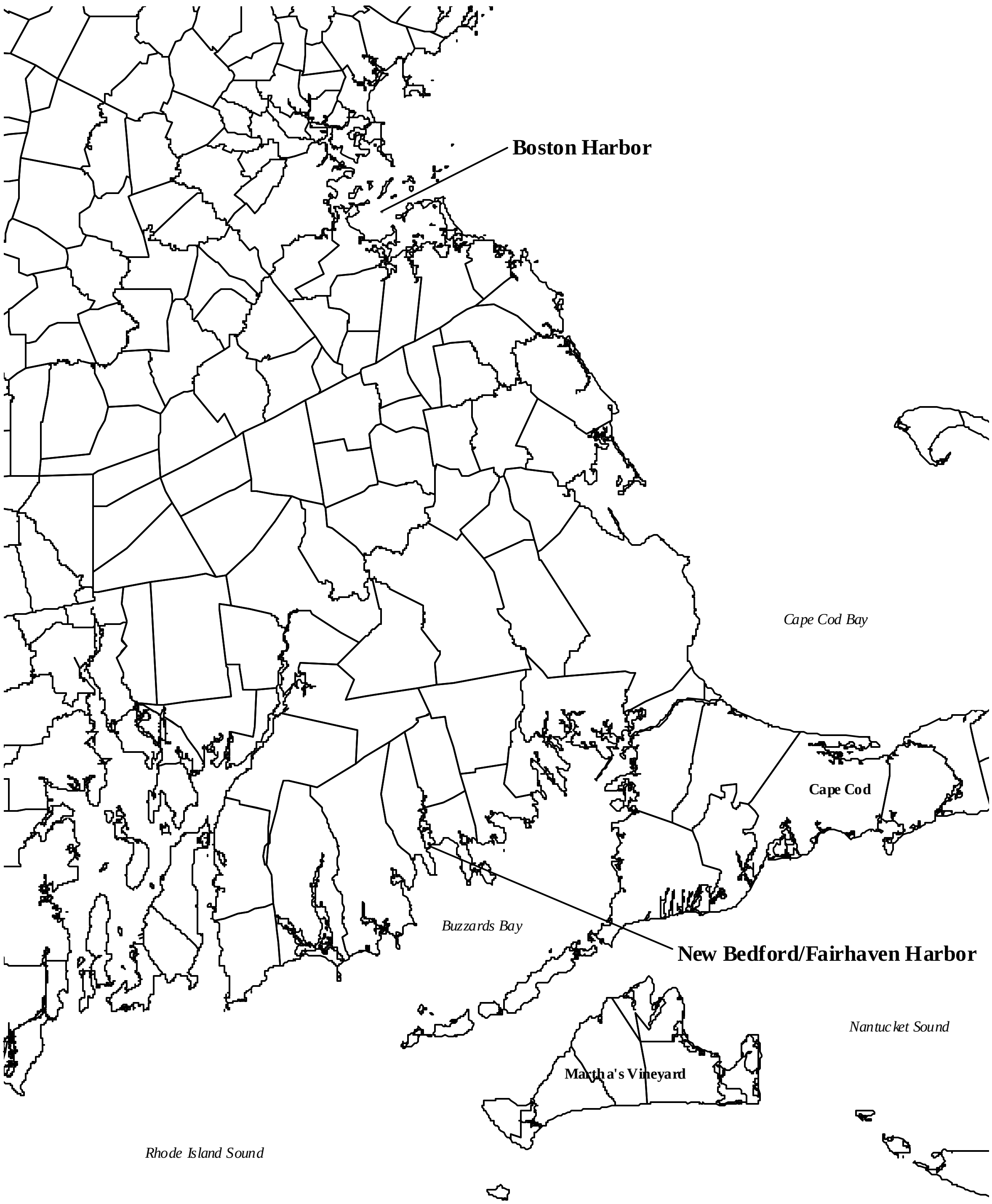


Figure 5-1: Location of New Bedford/Fairhaven Harbor (Base Map Source: MassGIS)

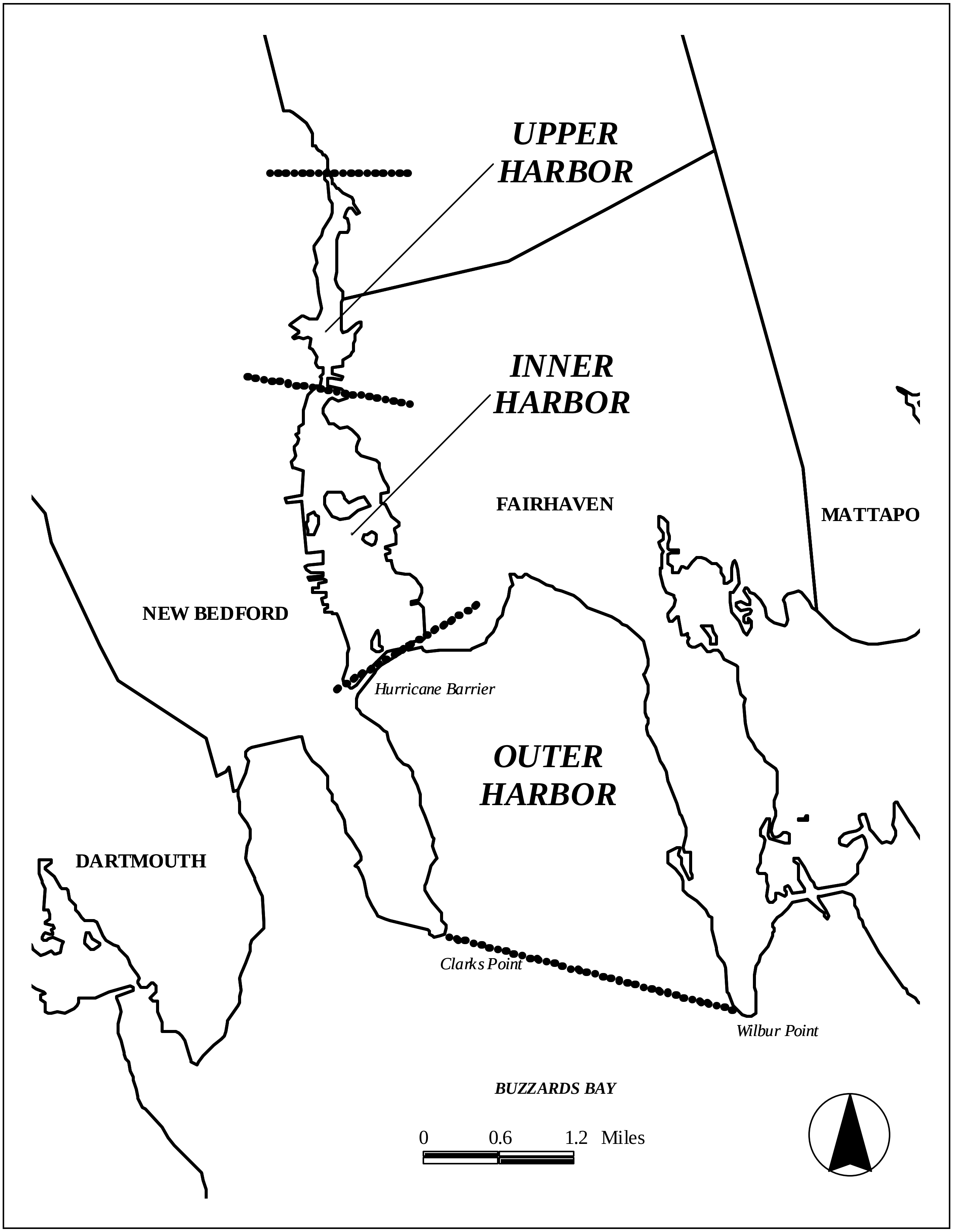


Figure 5-2: New Bedford/Fairhaven Harbor Upper, Inner and Outer Harbor Areas

East of Fort Phoenix lies the community of Harbor View on the west side of Priests Cove, a small embayment on the north shore of the Outer Harbor in Fairhaven. East of Priests Cove lies the Community of Pope Beach. Continuing south and counterclockwise along the western shore of the Outer Harbor lies Silver Shell Beach within the community of Sconticut Neck, a peninsula that extends southward from the middle of Fairhaven's southern shore. South of Silver Shell Beach lies a small unnamed tidal cove embayment and salt marsh. Further south lies the limits of Sconticut neck at Wilbur Point.

The main federal navigation channel leading into New Bedford/Fairhaven Harbor (the Entrance Channel) is authorized to a depth of 30 feet. It begins at a location just south of the Butler Flats Lighthouse in the Outer Harbor and continues northwesterly through the break in the seawall and into the Lower Harbor. The main navigation channel splits into two channels once inside the hurricane barrier. One channel provides access to the New Bedford Commercial Wharves (the New Bedford Reach) and the other (the Fairhaven Reach) provides access to the Fairhaven Wharves on the east side of the Lower Harbor. The New Bedford Reach terminates at an area between New Bedford Harbor to the west and Popes Island to the east. A turning basin authorized to a depth of 30 feet lies at the terminus of the New Bedford Reach. A maneuvering area lies adjacent to the west side of the New Bedford Reach between the commercial wharves and the reach (Figure 5-3).

The smaller Fairhaven tributary channel services the commercial wharves along the eastern shore of the Lower Harbor segment in Fairhaven. The Fairhaven Channel has an authorized depth of 15 feet adjacent to a 25-foot anchorage area within the Lower Harbor. This fifteen foot channel extends northeasterly between Crow's Island and Fairhaven. In the vicinity of Old South Wharf, the authorized depth of the Fairhaven reach changes from fifteen to ten feet (Figure 5-3).

The Upper and Lower segments of the Inner Harbor contains several marinas, a significant recreational fleet, harborside historical attractions, and various commercial fishing fleets and fish processing/cold storage facilities. Land usage along the western shore of the Outer Harbor contains a mixture of residential commercial and industrial uses. Land usage along the eastern shore of the Outer Harbor is predominantly residential.

5.2 Regulatory Environment

Disposal of dredged material and UDM in the aquatic environment of New Bedford/Fairhaven Harbor falls under the jurisdiction of several federal and state environmental programs. The principal federal jurisdiction is Sections 401 and 404 of the CWA, which regulates the disposal of dredged material and UDM in open water landward of the baseline of the territorial sea. Because the candidate aquatic disposal sites are landward of the territorial sea baseline, they are not regulated by Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) (a.k.a. Ocean Dumping Act).

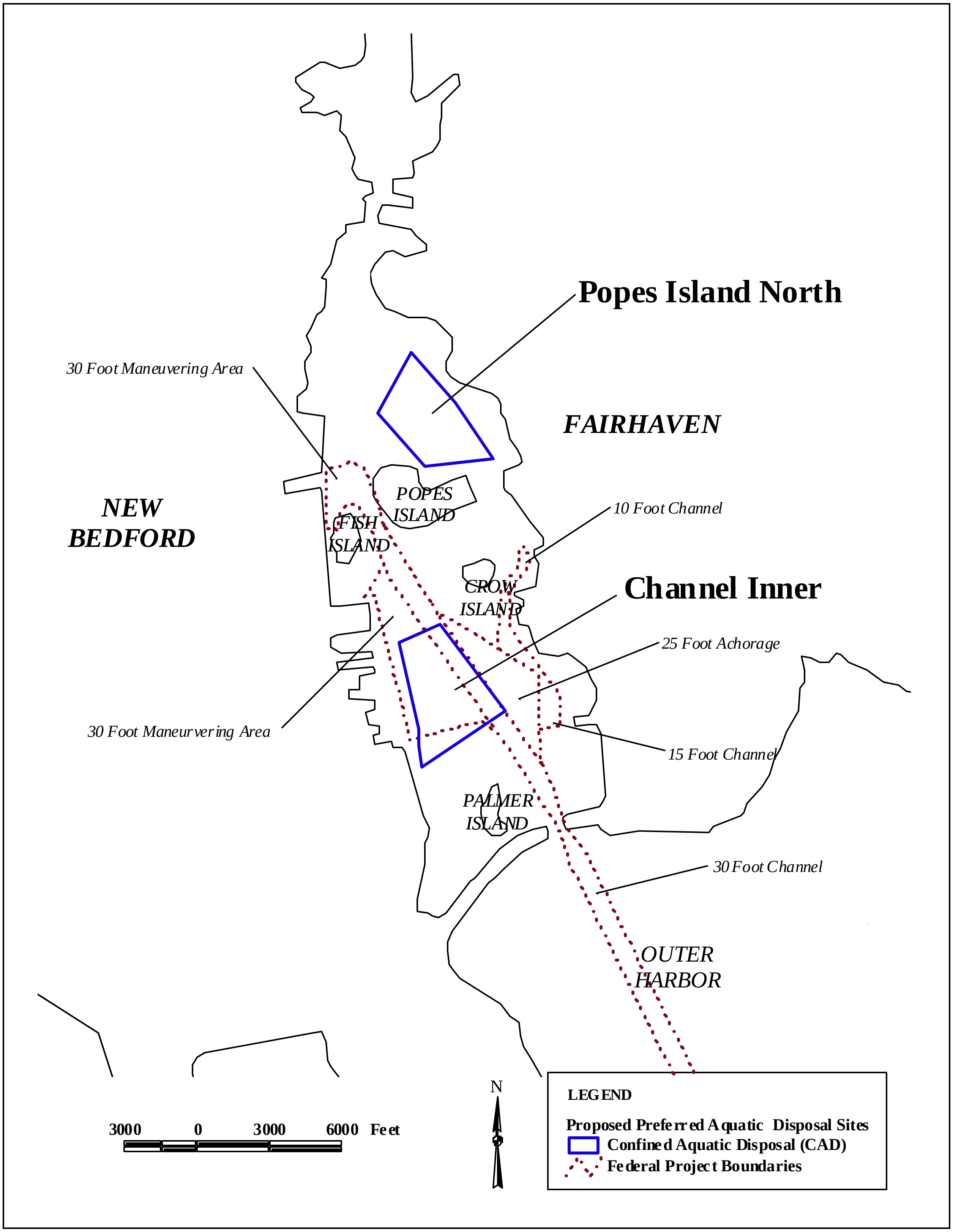


Figure 5-3: Federal Navigation Channels

The Section 401 Water Quality Certification program is administered by the DEP. A Water Quality Certificate must be issued for the disposal of dredged material and UDM within the limits of state waters, which extend from the shoreline seaward for three miles, or to the territorial sea baseline.

Other state regulatory programs include the Public Waterfront Act (Chapter 91 of the Massachusetts General Laws or MGL) and the Wetlands Protection Act, which govern dredged material and UDM disposal activities in the aquatic environment.

5.3 Marine Resource Characterization

Existing information pertinent to New Bedford/Fairhaven Harbor was collected and reviewed to characterize general sedimentary environments in the vicinity of New Bedford/Fairhaven Harbor. Recent fisheries information collected and surveys conducted for this project (NAI, 1999), were used in the characterization of existing fisheries and habitat resources of the region. Natural resources mapping prepared by the DEP (i.e.: eelgrass) and data provided by the Massachusetts Geographic Information System (MassGIS) office (i.e.: wetland resources) were also used.

Site-specific field studies were performed at each of the candidate sites to collect Sediment Profile Images (SPI) using the REMOTS® camera system (Rhoads and Germano, 1982;1986). These sediment-profile images provide valuable site-specific information on sediment types and biological activity.

Sediments to be dredged from within the channel were tested in 1997 to determine their suitability for unconfined aquatic disposal. The physical and chemical characteristics of the sediments at aquatic disposal sites were also determined.

A sub-bottom profile survey was conducted to determine the depth to bedrock in New Bedford/Fairhaven Harbor. This information was needed to estimate the potential capacity of the proposed CAD sites in the Harbor.

5.3.1 Sediments and Water Quality

Data regarding sediments (physical characterization, transport and circulation), and sediment quality was obtained from various regional and site specific studies including the following:

- Habitat characterization of the DMMP Candidate Aquatic Disposal Sites report to MACZM (Maguire Group, 1999);
- New Bedford Harbor Long Term Monitoring Assessment Report: Baseline Sampling. Research Report No. 600/R-96/097 (U.S.EPA,1996).
- Phase 2 Facilities Plan Effluent Outfall, City of New Bedford, MA (Camp, Dresser, & McKee, Inc. 1989)
- Overview of the New Bedford Harbor Physical/Chemical Modeling Program (EBASCO Services, Inc., 1991).

Water quality and water quality classification information was obtained from the following sources:

- Massachusetts Division of Marine Fisheries Designated Shellfish Growing Areas (MADMF, 1999)
- The DMMP, Phase I (Maguire Group, 1997).
- Ecological Profile of Buzzards Bay (Howes and Goerhinger, 1996).
- Feasibility Study of Remedial Activities for the Estuary and Lower Harbor/Bay (EBASCO, 1990).
- Buzzards Bay Project and Buzzards Bay Coalition (Costa, J., Howes, B., and E. Gunn, 1996; Howes, B., T. Williams and M. Rasmussen, 1999).

5.3.1.1 Physical Characterization of Existing Sediments

In general, fine-grained unconsolidated sediments overlaying till and bedrock were found throughout the New Bedford/Fairhaven Harbor as reported by Summerhayes, et al.(1985) (Figure 5-4). This type of sediment suggests a low-energy, depositional environment which is typical of protected coastal embayments with limited freshwater inflow and a moderate tidal influence. Others report a layer of glacially deposited sand and gravel atop the bedrock with a layer of organic silt covering the sand and gravel (EBASCO Services, 1988). Tests on composite grain samples taken from the upper two feet (0.6 meters) of sediment revealed that sediment from within and near the potential dredged material sites were predominantly within the silt to clay grain size range (Maguire Group 1997).

Laboratory analysis of sediment by the U.S.EPA (1996) using wet-sieving and pipette analytical techniques revealed that sediments from the relatively shallow Upper Harbor are composed primarily of fine-grained particle sizes with a high (40-80%) silt/clay content. However, localized areas of varying sediment composition were also identified, such as sandy shoal areas along the banks of the Acushnet River and gravelly bottom areas within scours produced by relatively faster currents beneath the Coggeshall Street Bridge. In the Lower Harbor, sediment grain size distribution appeared to be a function of water depth. In relatively shallow areas (<10 feet or <3m water depth), the sediments contain high (40 to >80%) silt/clay content. These areas occur along the northeast and southwest shorelines. In relatively deeper water areas (>32 feet or >10m water depth), the sediments contain a predominantly sand content (60 to >80%). Examples of these areas are the vicinity of and below the Coggeshall Street Bridge, and along the New Bedford reach of the navigation channel within the Lower Harbor.

The Channel Inner site was found to be a depositional sedimentary environment composed of very soft muddy sediments with methane bubbles. The REMOTS® sampling station within the Channel Inner site contained a Stage I community with an average RPD of 2 inches (SAIC, 1999).

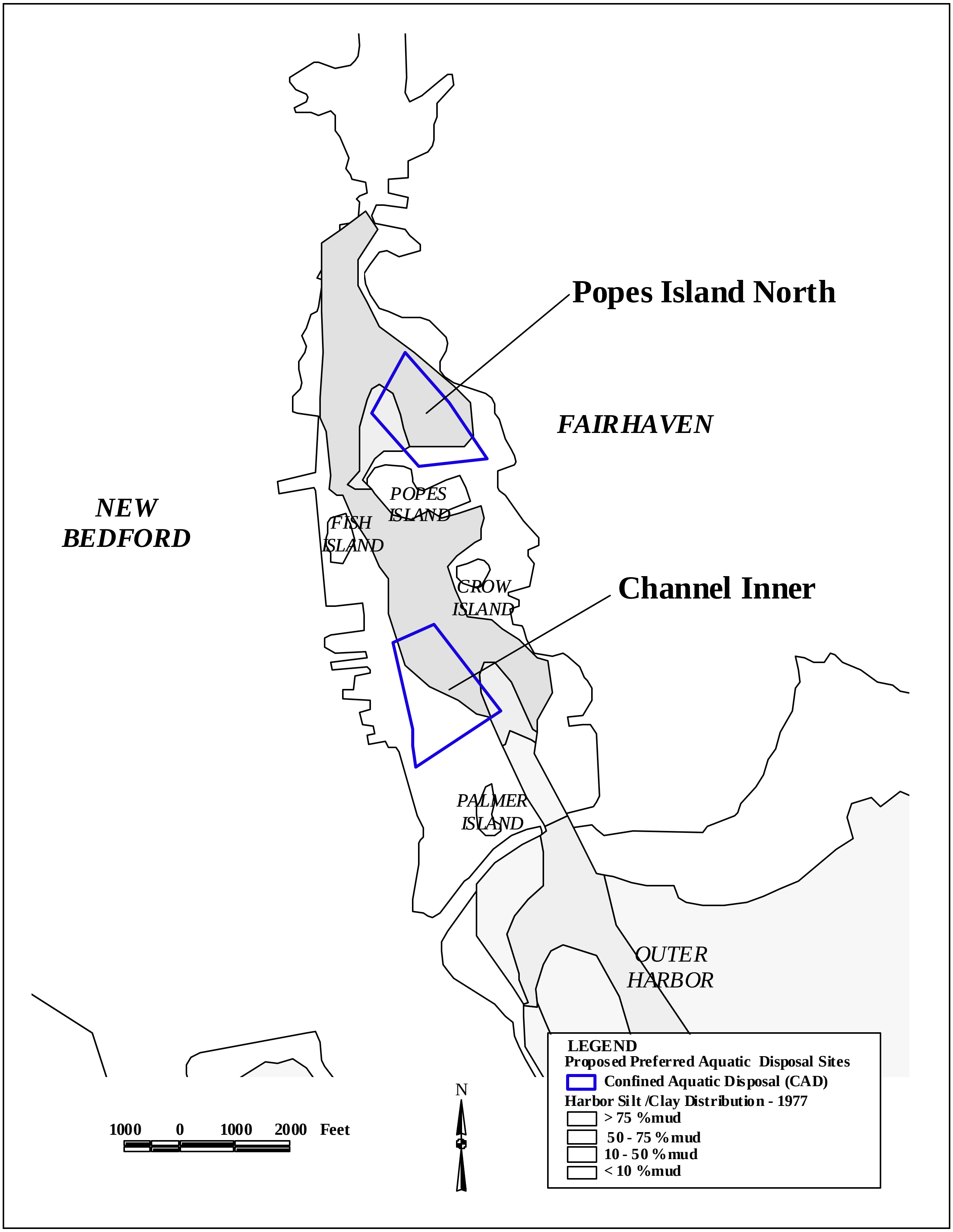


Figure 5-4: New Bedford/Fairhaven Harbor Sediment Size Distribution

The Popes Island North site in the Upper Harbor was found to be a depositional environment also, with homogenous soft silty sediments with little or no shell hash. The REMOTS sampling station within this site contained a Stage I community with an RPD between 1.19 to 2.31 inches (Figure 5-5). Lower RPD values and a Stage I designation are normally indicative of high-disturbance/degradation regimes in which the disturbance or degradation results in impact to habitat integrity (SAIC, 1999).

The Organism-Sediment index (OSI) is a metric which defines overall benthic habitat quality by assigning ranks and/or values to the depth of the apparent redox layer, successional stage of infauna, the presence/absence of methane gas in the sediment, and the presence/absence of reduced (i.e. anaerobic) sediment at the sediment-water interface. OSI values range from 1 through 10, with higher values representing stronger benthic habitat quality. The OSI value for the Popes Island North site was four (4), and the Channel Inner site was also four (4). A more detailed discussion of habitat conditions is presented in Section 5.3.2.2.

5.3.1.2 Sediment Transport/Circulation at the Proposed Preferred Disposal Sites

The circulation of water in coastal embayments such as New Bedford/Fairhaven Harbor is influenced by a complex combination of forces produced by basin morphology, tidal fluctuations, wind, and density gradients. Although general data regarding circulation conditions and sediment transport within the harbor has been collected (see below), no data exist describing the actual site-specific sediment transport and circulation patterns within each Proposed Preferred Aquatic Disposal sites and their proximity. Factors affecting potential sediment transport at this site is dependent on disposal site design.

Detailed site-specific information is required to project the fate of UDM placed at this location. At present, understanding of the magnitude and seasonal/spatial components of these physical forces is insufficient to quantify the long-term stability of UDM at the preferred disposal sites. Detailed, *in situ* measurements of tides, circulation, and patterns of sediment resuspension will be evaluated at each Proposed Preferred Aquatic Disposal site. This includes deployment of a tide gauge; current meters and other devices in order to provide a vertical profile of flows, bottom shear stress, and wave height. An OBS (optical backscatter) meter will be used to determine the relationship between wave heights, water currents, and sediment resuspension.

Nevertheless, the general sediment transport and circulation conditions within the vicinity of the Proposed Preferred Aquatic Disposal sites can be assessed using the existing available information to quantitatively determine the suitability of the proposed sites (refer to section 6.1.2). Circulation patterns within New Bedford/Fairhaven Harbor are primarily driven by meteorological events and mixed semi-diurnal tidal currents (EBASCO, 1991; Howes and Goerhinger, 1996; NBHTC, 1996). In the Upper Harbor, the mean tidal amplitude within the harbor is approximately 3.7 feet (1.1 meters). Spring tide range is reported to be 4.6 feet (1.4meters). In the Outer Harbor, the tidal range is reported to be from 1.41 feet (0.43meters) to 5.05 feet (1.54 meters) with a mean of 4.65 feet (1.42 meters)(ACOE, 1990). Flushing of the harbor was determined to take 2 days under winter conditions, and 8 days under summer conditions (Bellmer, 1988). Table 5-1 shows the effects during various time segments of the average tidal cycle.

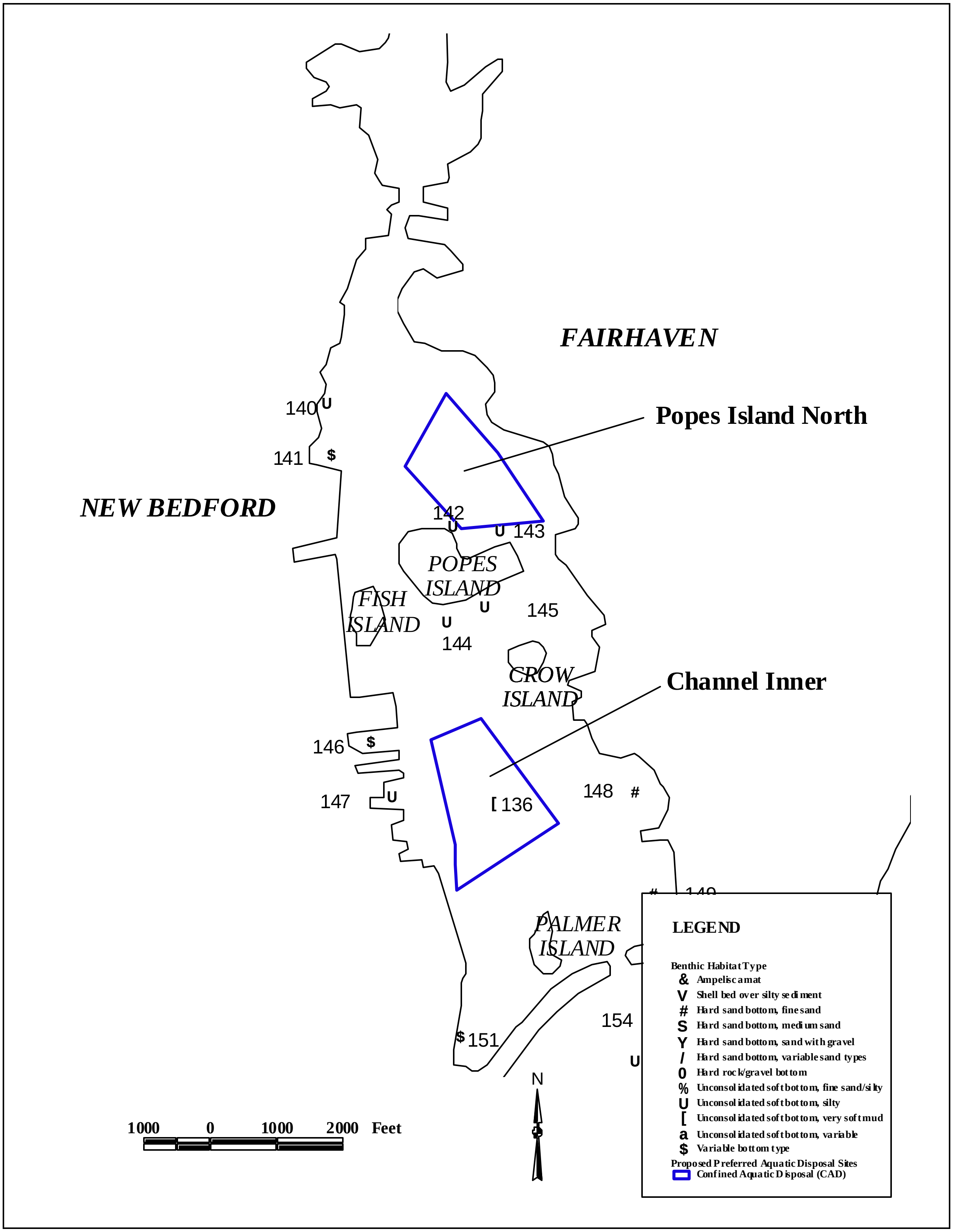


Figure 5-5: Benthic Habitat Type for Proposed Preferred Aquatic Disposal Sites

Local embayment and channel restrictions produce faster currents. Examples of these locations include: within the opening in the hurricane barrier, within the vicinity of Popes Island, and within the vicinity of the Coggeshall Street Bridge. At the Coggeshall Street Bridge, the average ebb tide velocity is 0.7 knots, however currents as fast as 3.5 knots have been recorded here during ebb tide (ACOE, 1990).

Meteorological forcing and storm-driven events may have a strong influence on sediment resuspension in the region. Despite the prevailing northwesterly winds blowing across Buzzards Bay during the winter, sediment resuspension is most prominent during episodic northeasterly storm events. These storms blow along the long axis of Buzzards Bay and during ebb tides can produce a reversal of bottom currents traveling northeast and upward to replace the waters driven southwest and out of the bay. In addition, the irregular bathymetry of Buzzards Bay causes eddies to form at the mouth of the bay, thereby affecting the transport or export of re-suspended sediment out of the Bay. During spring and summer, winds are typically from the southwest and west, waves are smaller and weaker, and resuspension is less likely (Howes and Goerhinger, 1996).

New Bedford/Fairhaven Harbor, however, is oriented to the south which makes it less susceptible to the more erosive storms and waves originating from the northeast throughout the winter. Therefore, local winds and other conditions may have a more significant effect on sediment resuspension within New Bedford/Fairhaven Harbor. Generally, water enters New Bedford /Fairhaven Harbor at lower depths, while water exiting the harbor does so at upper depths. This generalized flow can be strongly influenced by local wind conditions as surface shear can be strong enough to stall upper water column movements. Tidal effects (Table 5-1) are more pronounced at the Harbor's boundary with Buzzards Bay. Shoreward of this boundary, wind driven flows drive vertical mixing (Howes and Goerhinger, 1996).

Table 5-1: Current Velocity and Direction within New Bedford/Fairhaven Harbors during Various Segments of the Diurnal Tide

Tidal Segment	Time (hrs)	Current Velocity and Direction	Effect Distance
Flood	0	At beginning of tidal cycle 0.2 - 0.3 knot currents traveling northeasterly, enter the Outer Harbor	weak tides in Upper and Lower Harbor
	1-2	0.3 knot currents entering lower harbor	extending north into Upper Harbor
	3-4	maximum flood current velocity of 0.3 knots reached	extends north to I-195 bridge in Upper Harbor
	5-6	water level in estuary reaching maximum capacity; currents weaken.	0.3 knots still present in Outer Harbor
High Tide	6	current speeds, direction minimal	throughout
Ebb Tide	6-7	0.3-0.4 knot currents flow southeasterly in Outer Harbor	weak currents are present in the Inner Harbor
	7-11	Ebb tide begins to strengthen and reach 0.3 knots flowing south/southeasterly	as far north as I-195 bridge
Low Tide	>11	Currents diminish until next cycle	throughout

Source: NBHTC, 1996

5.3.1.3 Water Quality

Historically, waters of New Bedford/Fairhaven Harbor were utilized for the disposal of raw industrial and domestic sewage, as was typical of many tidal bays and estuaries in Massachusetts (Jerome et al, 1967; 1969). Pollution and the subsequent reduction in water quality have been a contributing factor to the disappearance of important commercial and recreational finfish species, as well as the closure or restriction of harvesting from shellfish beds in other Massachusetts ports (Costa, J., Howes, B., and E. Gunn, 1996; Howes, B., T. Williams and M. Rasmussen, 1999).

Water Quality Classification

The MADEP has established Water Quality Classifications for the Commonwealth's surface waters, as listed below. The Popes Island and New Bedford Channel Inner Proposed Aquatic Disposal sites are located within an area designated as SB (Figure 5-6). Class SB waters are designated as a habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. The Inner Harbor is also a designated combined sewer outfall (CSO) area and a designated Restricted Shellfish Area, defined below.

In addition to the classification system for surface waters, the Commonwealth has also denoted specific subcategories of use assigned to water segments that may effect the application of criteria or specific anti-degradation provisions of 314 CMR 4.05. Those restrictions pertinent to the siting of a disposal site for UDM from New Bedford/Fairhaven Harbor include:

Shellfishing – open shellfishing areas are designated as "(O)" and restricted shellfishing areas are designated as "(R)." These waters are subject to more stringent regulation in accordance with the rules and regulations of the DMF pursuant to M.G.L. c. 130 § 75. These include applicable criteria of the National Shellfishing Sanitation Program. Three "Shellfish Contaminated Relay Areas", priority Areas Nos. 1, 2, and 3, respectively (1 being the highest priority) as designated by the DMF are located within the Lower Harbor area of New Bedford/Fairhaven Harbor (Whittaker, personal communication). The primary area is located in the southwestern corner of the Lower Harbor. It is bounded by the Hurricane Barrier to the south, the eastern limit of the New Bedford Channel to the east, and the New Bedford Commercial Wharves to the west. It extends north along the harbor to a point proximal to the Edison Light Company Wharf. A portion of the New Bedford Channel - Inner Proposed Preferred Aquatic Disposal site lies within the northern limit of Priority area No. 1.

CSO – These waters are identified as impacted by the discharge of combined sewer overflows in the classification tables in 314 CMR 4.06(3). Overflow events may be allowed by the permitting authority without variance or partial use designation. New Bedford/Fairhaven Inner Harbor (including Upper and Lower segments) is designated a CSO area. CSOs occur along the western side of the Upper and Lower Harbors in the vicinity of the commercial wharves and along the eastern side of the harbor in the vicinity of the Fairhaven commercial wharves. The Fairhaven Wastewater Treatment Plant sewage outfall pipe is also located at the east side of the Lower Harbor, just south of the Fairhaven commercial wharves.

Currently, treated wastewater is discharged via two outfall pipes located at the seaward limit of the Outer harbor. The first pipe, a 60 inch diameter cast iron pipe is located approximately 3,300 feet (1000 meters) southeast of Clark's Point. The second pipe is used as an auxiliary pipe. It is a 72-inch diameter prestressed concrete pipe that is located alongside the primary pipe and extends approximately 1,000 feet (303 meters) southeast of Clark's Point (CDM, 1990).

Water Quality Sampling

Physical and chemical water quality parameters were measured within the various Harbor regions and adjacent Buzzards Bay during various harbor studies. Water quality measurements have been taken in several locations within the New Bedford/Fairhaven Harbor. New Bedford/Fairhaven site-specific data from NAI (1999), EBASCO (1990) and Howes and Goehringer (1996) are summarized herein. Basic water column physical data (temperature, salinity, dissolved oxygen, turbidity) was taken from the Feasibility Study of Remedial Alternatives for the Estuary and Lower Harbor/Bay (EBASCO, 1990). Chemical data was also obtained from EBASCO (1990). Information provided in Howes and Goehringer was used to portray expected phytoplankton conditions in New Bedford/Fairhaven harbor since New Bedford/Fairhaven Harbor is hydrologically connected to Buzzards Bay. Figure 5-6 indicates state water quality classification areas.

Physical Parameters

Generally, as one moves from oceanic water areas landward toward and into enclosed coastal waters, one can expect greater turbidity, wider temperature ranges, higher nutrient concentrations and more variable salinity (Hiscock, 1986). In New Bedford/Fairhaven Harbor, water temperature, salinity and dissolved oxygen (DO) were collected during finfish sampling efforts (seining and trawling) from June 1998 through May 1999 (NAI, 1999) (refer to Section 5.2.4 Finfish). During the finfish sampling study, water quality sampling conducted at each seine and trawl sample stations revealed that monthly mean water temperature followed a predictable seasonal pattern (Figure 5-7). Water temperatures were generally highest in August (seine: 22.1 to 22.5 ^{o} C; trawl: 21.8 to 25.5 ^{o}C) and lowest in January (seine: 1.6 ^{o} C; trawl: 2.5 ^{o}C). Salinity did not vary appreciably during the months sampled or by location among the harbor sampling sites. In the seine, monthly mean salinity ranged from 25.0 ppt at one seine station (NS1 - at the Outer Harbor at Ferry Dock) in October, to 31.4 ppt at a trawl station (NT1 - at the seaward end of the Outer Harbor) in November.

Prior to a 1989 Superfund Pilot Study and Evaluation of Dredging and Dredged Material Disposal, the United States Army Corps of Engineers (1990) conducted pre-operational sampling and water quality characterization of the New Bedford/Fairhaven Harbor on nine separate days between 9 July 1987 and 23 June 1988. This sampling effort was conducted in order to determine existing ranges of physical, chemical, and biological response variables that occur in the harbor. Mean salinity, as measured from the Coggeshall Street Bridge, ranged from 24 - 30 parts per thousand (‰) during the diurnal tidal cycle; results that are comparable to those obtained during the finfish sampling (NAI, 1999).

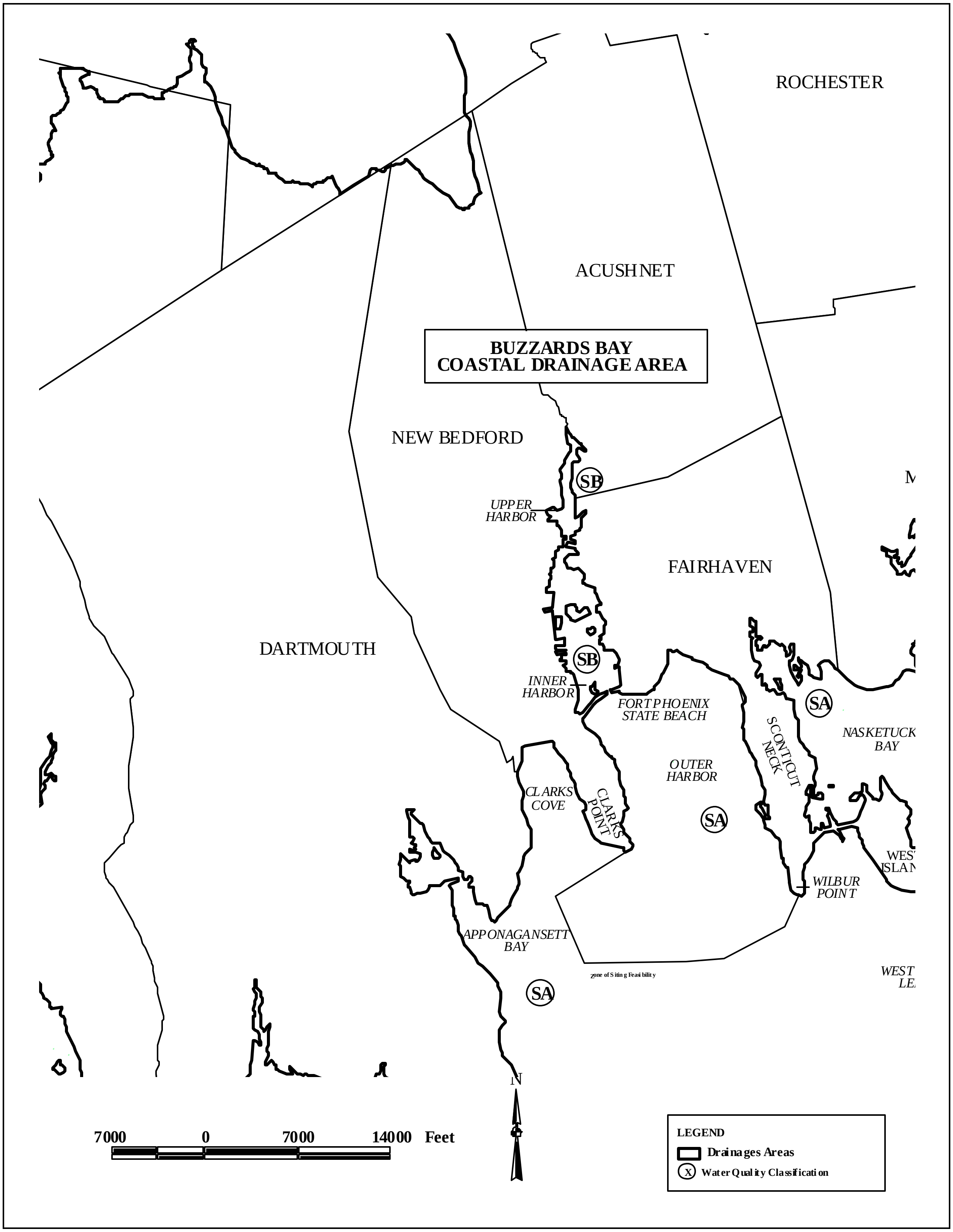


Figure 5-6: Water Quality Classification Areas

The upper end of the salinity range is very close to the average salinity concentration reported for inshore waters (Gosner, 1978), while the lower range reflects the limited freshwater input of the Acushnet River to New Bedford/Fairhaven Harbor. Temperature as measured from the same location was found to range from 18.5 ºC. to 23.5 ºC. Total Suspended Solids (TSS) was measured at two stations within the Harbor. At the first location, the Coggeshall Street Bridge, TSS ranged from 6.4 - 8.3 mg/l during ebb tide, and 6.8 - 10.2 mg/l during flood tide. At the second location, the Hurricane Barrier, TSS ranged from 4.4 - 7.9 mg/l during ebb tide, and 6.6 - 7.8 mg/l during flood tide. These values are within the range reported by Batelle Ocean Sciences (1991) of less than 10 mg/l under normal conditions. During storm events, TSS concentrations can reach 40 mg/l. Currents were measured at 10 to 50 cm/sec (0.19 to 0.97 knots). The tidal range was found to be 5.2 feet (1.6 m) (USACOE, 1990).

During finfish sampling within the Harbor, dissolved oxygen was reported to be at saturation from January to May. It ranged from a low of 7.9 mg/l at one seine station(NS3 - located northeast of Crow Island in the Lower Harbor) in October to 13.5 mg/l at one trawl station (NT4 - located within the middle of the Lower Harbor) in February.

Turbidity is reportedly 1 - 1.5x greater in bottom waters than in surface waters with the greatest values typically measured one hour after maximum flood velocity. Suspended sediment is generally lowest within the Harbor during winter and highest during early spring through early summer (BOS, 1991). This is attributed to freshwater inflow, since suspended sediments are typically highest during spring, due to seasonal increases in precipitation and resultant runoff. Exceptionally high turbidities can also be expected form suspended sediment in areas relatively exposed to tidal or storm induced wave energy.

Chemical Parameters

Batelle Oceanic Sciences (BOS, 1990) determined mean PCB concentrations from 18 sampling locations through the study area. This study found PCB concentrations in water samples to range from 5 to 7,635 ng/l (refer to Table 5-2). Concentrations were highest within the Upper Harbor, just south of the Wood Street Bridge, and decreased downstream to the lowest values in Buzzards Bay.
Filterable and total PCB was also determined from the surface water collected at the Coggeshall Street Bridge and Hurricane Barrier during the New Bedford Harbor Superfund Pilot Study (USACOE, 1990). PCB was reported in the surface water at a concentration of 607 ng/l during ebb tide at the Coggeshall Street Bridge and 114 ng/l at the Hurricane Barrier. These findings corroborate those reported by BOS in EBASCO (1990) and represent levels that exceed the national marine water criteria of 30 ng/l.

Three heavy metals, Cadmium (Cd), Copper (Cu), Lead (Pb), were also measured at these two locations during this water quality characterization study. According to the methods section of the report, both total and filterable concentrations were determined. However one data set is reported and the phase (i.e: total vs. filterable) is not specified. The reported results are likely to be the dissolved fraction determined as a product of the total minus filterable fractions (i.e. total - filterable
= dissolved). The values for the three metal elements as reported are 0.20 ug/l, 3.4 ug/l and 6.5 ug/l, respectively, for the Coggeshall Street Bridge location and 0.11 ug/l, 2.3 ug/l, and 2.9 ug/l, respectively at the Hurricane Barrier (USACOE, 1990).Values reported for cadmium are below the mean of 9.5 ug/l presented in Manahan (1991) for trace metal concentrations in waters of the United States. Those reported for copper are below the mean of 15 ug/l, and those of lead below the mean of 23 ug/l (Manahan, 1991).

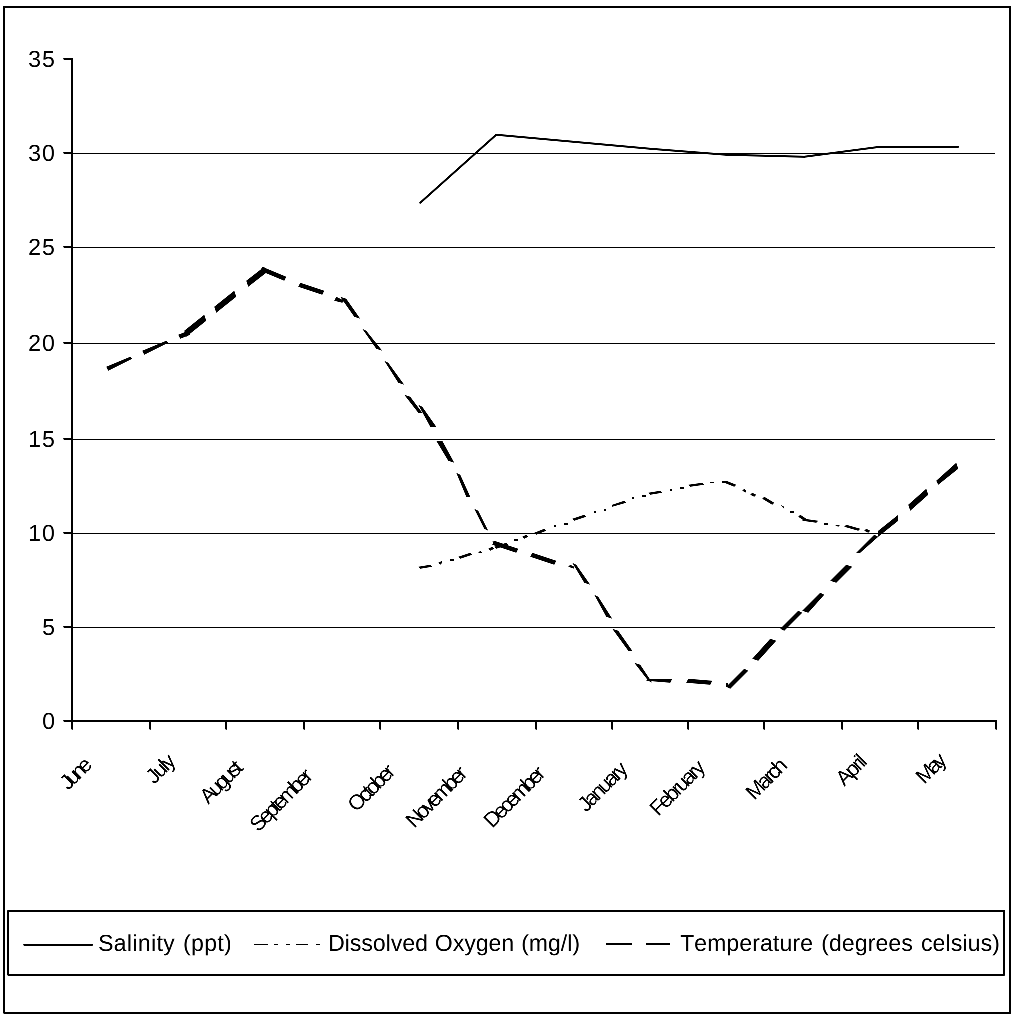


Figure 5-7. Mean Salinity, Dissolved Oxygen and Temperature at Stations NS1-3 and NT1-5 in New Bedford/Fairhaven Harbor (NAI 1999)

Table 5-2: Results of Surface Water PCB sampling throughout New Bedford/Fairhaven Harbor and Buzzards Bay in 1987

Sampling Station No.	Sampling Location	Concentration (ng/l)[1]
1	Upper Harbor: Acushnet River just south of Wood St. Bridge	7635
2	Upper Harbor: North of Coggeshall Street Bridge	1021
3	Upper Harbor: South of Coggeshall Street Bridge	269
4	Upper Harbor: Middle	209
5	Lower Harbor: West of Popes Island	170
6	Lower Harbor: Northeast of Popes Island **(Closest sampling station to Popes Island CAD Site)**	318
7	Lower Harbor: North-central	93
8	Lower Harbor/Outer harbor Interface	142
9	Lower Harbor East **(Closest sampling station to Channel Inner Site)**	91
10	@ Hurricane Barrier entrance	111
11	West Side of Outer Harbor	90
12	Outer Harbor Channel - North End	46
13	East Side Outer Harbor	15
14	Outer Harbor Channel - Middle	26
15	Outer Harbor Channel - South End	14
16	Clark's Point Sewer Outfall	25
17	Clark's Cove	12
18	Buzzards Bay	5

Source: Batelle Oceanic Sciences (BOS)**.** *In*: EBASCO (1990).

[1] ng/l = nanograms per liter or parts per trillion

Notes: Highlighted values exceed Alternate Water Quality Concentrations (chronic effects on aquatic life at 30 ppt.) The decreasing concentrations in water from estuary to Lower Harbor and Buzzards Bay correlate with the decrease in sediment concentrations in the same direction.

Biological Parameters

Chlorophyll *a* concentrations range from 10 mg/m^3 in nutrient enriched embayments of Buzzards Bay to 1 - 2 mg/m^3 at the mouth of the bay (Howes and Goehringer, 1996). The western shore of New Bedford/Fairhaven Harbor is a likely source of nutrient input as reflected by the relatively high annual primary production rates of 360 g C m^{-2} year^{-1} as compared to the eastern shore of the harbor (106 g C m^{-2} year^{-1}) or baywide (230 g C m^{-2} year^{-1}). High temporal and spatial variability in chlorophyll concentration is characteristic of shallow near shore embayments, caused by fluctuations in riverine inflow, wind-driven turbulence, or patchy nutrient distribution. The first and largest bloom typically occurs in late winter to early spring with the warming of surface waters and the introduction of nutrients from freshwater inflow. In New Bedford/Fairhaven Harbor, seasonal patterns and bloom conditions similar to those reported for other estuaries within the same ecoregion (i.e.: Atlantic temperate climates) are expected. Seasonal variation in phytoplankton production are illustrated by chlorophyll *a* concentrations in surface water. Therefore, the western side of the Outer Harbor is more susceptible to nuisance algal blooms than other areas of the Outer Harbor. The Upper and Lower Harbors are also susceptible for this same factor but with the added disadvantage of reduced tidal flushing compared to the Outer Harbor. Nevertheless, nuisance algal blooms (e.g. red tides) historically have not had a significant impact on biological resources in Buzzards Bay to date (Howes and Goehringer, 1996).

5.3.1.4 Sediment Quality

Sources of potential contamination within New Bedford/Fairhaven Harbor were evaluated during the Due Diligence review in Phase I of the Dredged Material Management Plan (Maguire, 1997). As part of the Due Diligence review, a database search of existing local, state, and federal environmental files for reported releases of regulated substances (e.g. oil, hazardous chemicals) was conducted. The results of this review revealed thirteen (13) reported hazardous or other regulated material release incidents for New Bedford/Fairhaven Harbor. However, details regarding the identity, quantity and exact location of release for some incidents are incomplete. Available details regarding these releases (as recorded on the incident reports) are provided in Table 5-3.

The shoreline of New Bedford/Fairhaven Harbor is a dense mix of residential, commercial and industrial land uses (Maguire Group Inc., 1997). Within this developed area, there are 23 facilities permitted to discharge wastewater under the National Pollutant Discharge Elimination System (NPDES) within the New Bedford/Fairhaven Harbor area. The remaining sites are classified as a minor discharge source and are also located throughout the harbor’s commercial areas. Existing and historical combined sewer outfalls or CSOs (see above) have also likely contributed pollutants to the Inner and Outer Harbors as well. Collectively, all these point sources have resulted in the discharge of heavy metals, PCBs, PAHs, and nutrients to the harbor. These contaminants are all detectable in the harbor’s sediment (Figure 5-8).

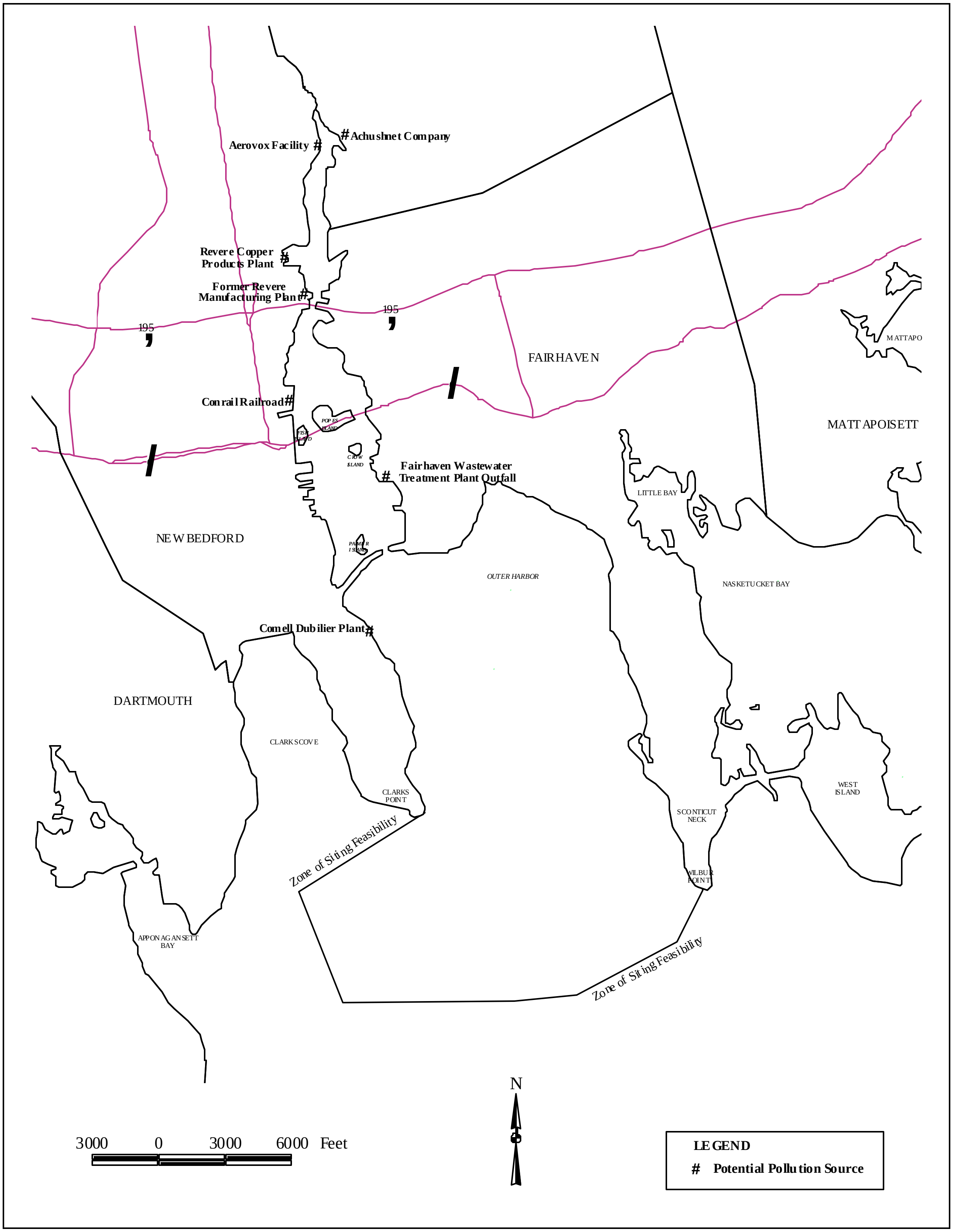


Figure 5-8: Primary Pollution Sources

Table 5-3: Reported Releases of Hazardous and Other Regulated Materials within New Bedford/Fairhaven Harbor from 1990 to 1997.

State or Federal Incident ID #	Location as Reported	Report Date	Material	Quantity	Units
3149	State Pier	7/17/90	unknown	251-500	gallons
2399	Fish Pier/ Leonard's Wharf	2/25/91	Diesel Fuel	10-50	gallons
2257	New Bedford Harbor	8/10/91	no. 2 fuel oil	unkown	unknown
2919	Seafood Coop	2/16/92	no. 2 fuel oil	1001-5000	gallons
2835	Palmer's Cove	3/8/92	Petroleum	unknown	gallons
3138	Steamship Pier	3/24/92	Petroleum	unknown	gallons
3136	State Pier No. 3	4/7/92	Petroleum	unknown	unknown
1733	Near Steamship Pier	4/28/92	Diesel Oil	100	gallons
3137	State Pier	8/12/92	Petroleum	unknown	unknown
3142	Pier 3	11/27/92	Petroleum	unknown	unknown
3166	North of State Pier	8/14/93	Waste Oil	1-10	Drums
2386	Fairhaven Bridge, Rt. 6	2/14/94	Oil	55	gallons
1424	North Terminal, New Bedford Harbor	6/7/96	Oil	Sheen: 1/4 x 1/4	miles

Source: Maguire Group, 1997

Sediment quality testing conducted in New Bedford/Fairhaven Inner Harbor Federal Channel in 1997, confirmed the presence of heavy metals (total copper, cadmium, lead, and total PAHs and PCBs in excess of Massachusetts Bay Disposal Site Reference Criteria.) These results were anticipated due to the proximity of adjacent waterfront pollution sources, and the historic sediment contamination in this area (Maguire Group 1997). Table 5-4 lists the average sediment contaminant concentration within each proposed preferred aquatic disposal site.

Table 5-4: Selected Surficial Sediment Chemistry Sampling Results
New Bedford/Fairhaven Harbor

Parameter	Units	Channel Inner CAD	Popes Island North CAD	Sampling Depth as Reported	Data Source	MBDS Reference
% Fines (silt/clay)	%	66.9 - 91.2	N/A	0 - 4 ft	MGI (1998)	88%
Arsenic	mg/kg	6 - 10	N/A	0 - 4 ft	MGI (1998)	28.7
Cadmium	mg/kg	0.39 - **5.7**	N/A	0 - 4 ft	MGI (1998)	2.74
Chromium	mg/kg	37 - **250**	N/A	0 - 4 ft	MGI (1998)	152
Copper	mg/kg	**200 - 540**	**101 - 500**	0 - 4 ft; 0 - 2 cm at Popes Island North 2	MGI (1998); USEPA (1996) for Popes Island North 2	31.7
Mercury	mg/kg	**0.54 - 1.3**	N/A	0 - 4 ft	MGI (1998)	0.277
Nickel	mg/kg	11 - 33	N/A	0 - 4 ft	MGI (1998)	40.5
Lead	mg/kg	**78 - 160**	N/A	0 - 4 ft	MGI (1998)	66.3
Zinc	mg/kg	140 - **380**	N/A	0 - 4 ft	MGI (1998)	146
Total Metals (Cadmium, Chromium, Copper, and Lead)	mg/kg	N/A	0-500 in center embayment, 500-100 around outer perimeter	0-6 in	EBASCO (1990)	ng
Total PAHs	ug/kg	68.1 - **9010**	N/A	0 - 4 ft	MGI (1998)	2,996
Total PCBs	mg/kg	<1 @ NW corner; 10-50 @ SW corner	0-500 in center embayment	0-6 in	EBASCO (1990)	ng

ng = no guideline
N/A = Not Available - Site specific data to be collected for the FEIR
*numbers in **bold** are above MBDS reference*

Potential sources of pollutants remain in the harbor watershed, due to the number of high risk industries within the commercially developed areas surrounding the harbor. For instance, the known one hundred (100) state hazardous waste sites within the New Bedford/Fairhaven Harbor watershed have been responsible for the release of PCBs, petroleum hydrocarbons, volatile organic compounds, and heavy metals to the soil, surfacewater, groundwater, and sediment media around the harbor. These sites include numerous gasoline filling stations, automotive service stations, fuel companies; autobody repair shops, and various manufacturing and industrial facilities.

5.3.1.5 Harbor Superfund Project

The Acushnet River watershed is the most urbanized area in the Buzzards Bay drainage basin and New Bedford/Fairhaven Harbor is the most contaminated area in the drainage basin (USEPA 1999). The harbor is contaminated with metals and organic compounds, including polyhlorinated biphenyls, commonly known as PCBs. Because of the high concentrations of PCBs in the sediment, the harbor was listed as a Superfund site in 1982.

The New Bedford Harbor Superfund Site is an 18,000 acre urban estuary reaching from the upper Acushnet River into Buzzards Bay (Figure 5-9). The cleanup of the Superfund site has been divided into three phases or "operable units": the hot spots, the upper and lower harbor and the outer harbor areas (Buzzards Bay area) (USEPA 1999). At the present time, there are no further plans to deal with sediments contaminated by chemicals other than PCBs (USEPA 1999).

In the late 1930s and early 1940s, two electronic parts manufacturers occupied empty textile mill buildings on the waterfront in New Bedford (Aerovox Corporation in 1939 and Cornell-Dubilier in 1941). These companies used PCBs in the manufacture of capacitors and discharged waste directly into the surrounding waters until the late 1970s, when the use of PCBs was banned by the EPA (USEPA 1999). As a result, the harbor is contaminated in varying degrees for at least 6 miles, from the upper Acushnet River into Buzzards Bay (USEPA 2002).

Other industries also released metals and organic compounds into the harbor. The impact of the development of the watershed combined with the construction of the hurricane barrier have effected sedimentation patterns, increased water residence times and altered water circulation patterns, permanently altering the ecology of the harbor.

In 1994, five of the most contaminated areas containing PCB-contaminated sediment (14,000 cy) were removed from the Acushnet River by the USACE (USEPA 2000). The hot spot sediments were ultimately disposed of at an offsite TSCA permitted facility in New York State (USEPA 2000). The USEPA, in September 1998, selected a dredging and shoreline containment method (CDFs) for approximately 450,000 cy of contaminated sediment, north of the hurricane barrier (USEPA 2000). Currently, the USEPA is now exploring another alternative, the upland disposal of the remaining Superfund material. The EPA will conduct additional investigations of the outer harbor (Buzzards Bay area) to determine if cleanup actions are necessary in the outer harbor.

Based upon many years of research and analysis of sediment contaminants, the USEPA has determined that presence of PCBs in the harbor poses threats to ecological and public health (see Section 5.3.12). As part of the remedy to restore the health of the harbor, target cleanup levels (TCL) were established for various portions of the harbor. The TCL for PCBs in the Lower Harbor has been set at 50 ppm. Evaluation of material to be dredged as part of the DMMP, while not suitable for open ocean disposal was also determined to be below the TCL and is therefore not Superfund material. Detailed discussion of sediment tested for the DMMP is included in Section 3.3.2.

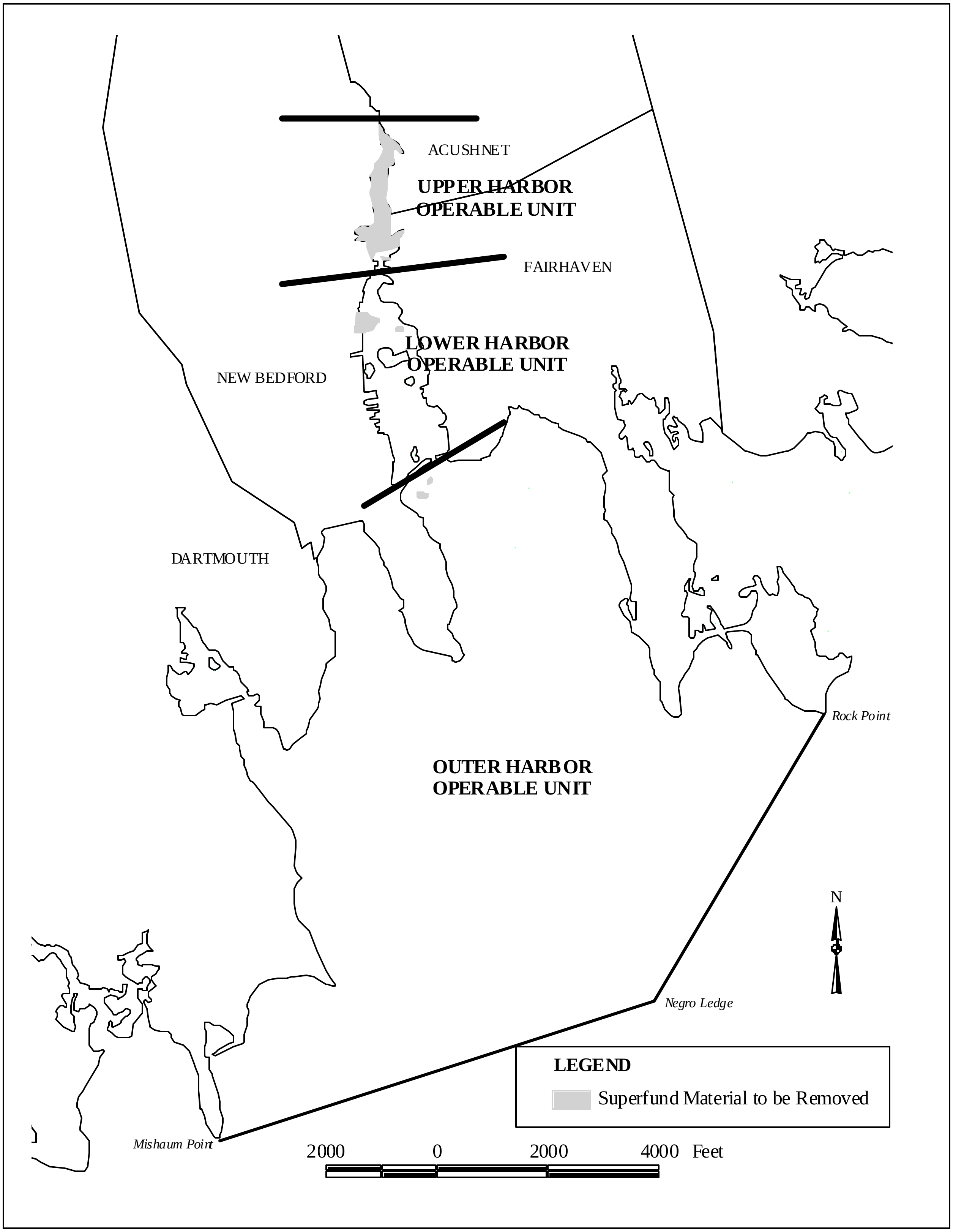


Figure 5-9: Harbor Superfund Project

5.3.2 Benthos

5.3.2.1 General

The term benthos refers to the community of organisms living in or on top of the sediments. For the purposes of this report, the term does not include finfish, although some finfish may live on the bottom (e.g. winter flounder). Benthic organisms include those valued for human consumption such as lobsters, clams, mussels, as well as many non-commercial species such as segmented worms, other bivalves, and various crabs.

The benthos of New Bedford/Fairhaven Harbor is discussed in four categories. First, the overall benthic habitat is described based on a REMOTS® survey (Valente, 1999) done in 1998 for this project. Second, the benthic invertebrate communities of the Upper, Lower and Outer Harbors are described. Third, the commercially and recreationally harvestable mollusks are discussed based on surveys conducted as part of DMF and other studies. Information regarding benthic invertebrates and benthic invertebrate habitat include the following sources:

- Habitat characterization of the DMMP Candidate Aquatic Disposal Sites report to MACZM (Valente, 1999);
- Massachusetts Division of Marine Fisheries Designated Shellfish Growing Areas (MADMF, 1999)
- The DMMP, Phase I (Maguire Group, 1997).
- Ecological Profile of Buzzards Bay (Howes and Goerhinger, 1996).
- Quahog Standing Crop Survey - New Bedford Inner and Outer harbors. Commonwealth of Massachusetts. Division of marine Fisheries (Whittaker, 1996).
- Dredged Material Management Plan Quahog Resources Survey for New Bedford and Fall River (NAI, 1999).

5.3.2.2 Benthic Habitat Conditions

In an effort to gain some general information on benthic habitat conditions at the candidate aquatic disposal sites Valente, et. al., (1999) conducted REMOTS® sediment-profile imaging surveys. The REMOTS® system uses a specialized camera to photograph a vertical cross-section of the seafloor to a depth of 15 to 20 cm. Data obtained from the photographs include sediment type, presence of macrofauna, presence of methane bubbles, and depth of oxidized sediments. The depth of oxidized sediments is apparent in the photographs as the boundary between colored surface sediment and underlying gray to black sediment, called the apparent redox potential discontinuity (RPD). The depth of the RPD is increased by the presence of bioturbating macrofauna. The foregoing parameters can be used to determine habitat type and infaunal successional stages, and to calculate an Organism-Sediment Index (OSI), an indicator of habitat quality of soft-bottom benthic environments. OSI values of less than 0 indicate degraded habitat quality, values of from 0 to +6 reflect intermediate quality, and values greater than +6 are indicative of good quality or healthy benthic habitats. During REMOTS® sampling, various sampling locations were chosen including stations within or adjacent to the current Proposed Preferred Aquatic Disposal Sites (Figure 5-10).

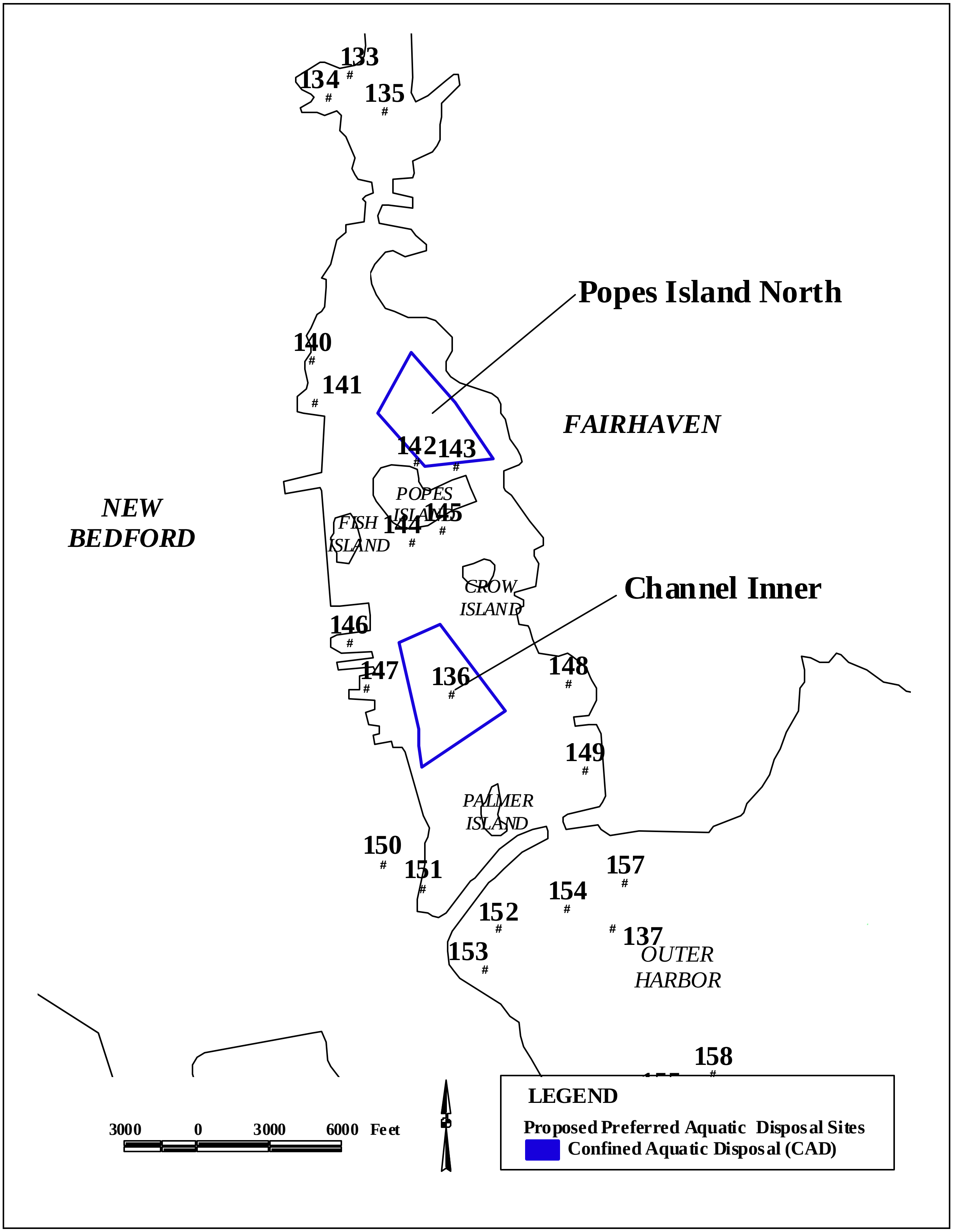


Figure 5-10: REMOTS Sediment Profile Images

Delineation of the Proposed Preferred Aquatic Disposal sites was conducted after REMOTS® sampling. One REMOTS® station was located at the Channel Inner site, (Station 136: two replicates), and two REMOTS® sampling sites were located proximal to the Popes Island North Site; one on the west end of the site (Station 142: four replicates) and one on the east end of the site (Station 143: four replicates). The results of the REMOTS® imaging obtained at each sampling station within or proximal to the Proposed Preferred Aquatic Disposal Sites are presented in Table 5-5.

The images indicate that the Channel Inner site is characterized by unconsolidated, fine-grained sediment having a grain size major mode of >4 phi (i.e., silt-clay). This resulted in the habitat type being classified as “UN.SF”. The predominance of fine-grained sediment, and the geographical location of the site indicates that this is a depositional sedimentary environment.

The mean depth RPD depth ranged from 1.94 cm at Popes Island North to 2.1 cm at Channel Inner. These are moderate RPD values indicative of limited sediment aeration. The change in optical reflectance (i.e., color contrast) between the light-colored, aerobic surface sediment and the underlying dark, anoxic sediment is distinct in each image (Figures 5-11a-b). The black color of the underlying sediment suggests a high inventory of sulfides and high sediment oxygen demand, possibly related to elevated levels of organic loading within the Inner Harbor.

The REMOTS® infaunal successional stage was consistently determined to be Stage I images obtained from each REMOTS® sampling station within or proximal to the sites. The Stage I designation is due to the presence of small, opportunistic, tubicolous polychaetes at the sediment surface. Stage III organisms were evident in only one Channel Inner image. Both Stage I and Stage III organisms can co-exist and are known to exploit the fine-grained, organic-rich, soft mud which characterizes the sites. The presence of larger-bodied, Stage III infauna helps to explain the relatively well-developed RPD depths at the Channel Inner Site (compared to RPD values of <2 at the northern limits of the Inner Harbor). The feeding and burrowing activities of Stage III deposit feeders (bioturbation) result in increased sediment aeration and hence deeper RPD depths.

Mean OSI values at Popes Island North and Channel Inner were 4, indicative of moderately degraded habitat conditions. Stage I organisms were the dominant benthic type at these sites.

Table 5-5: Results of the REMOTS® Imaging Obtained at Sampling Stations within or Proximal to the Proposed Preferred Aquatic Disposal Sites

Proposed Preferred Aquatic Disposal Site	REMOTS® Station Nos.	Dominant Benthic Invertebrate Successional Stage	Median Grain Size	Mean RPD (cm)	Mean OSI	Dominant Habitat Type/ quality
Channel Inner	136	Stage I	>4 f	2.1	4	UN.SF/ moderately degraded, recently disturbed
Popes Island CAD	142 (West End) 143 (East End)	Stage I	4 to 3 f	1.94	4	UN.SI/ moderately degraded, recently disturbed

Key:
- RPD: Redox Potential Discontinuity (Refer to Text for Definition)
- OSI: Organism-Sediment Index (Refer to Text for Definition)
- UN.SI Silty Soft Bottom
- SH.SI Shell Bed over silt
- UN.SF Muddy Soft Bottom

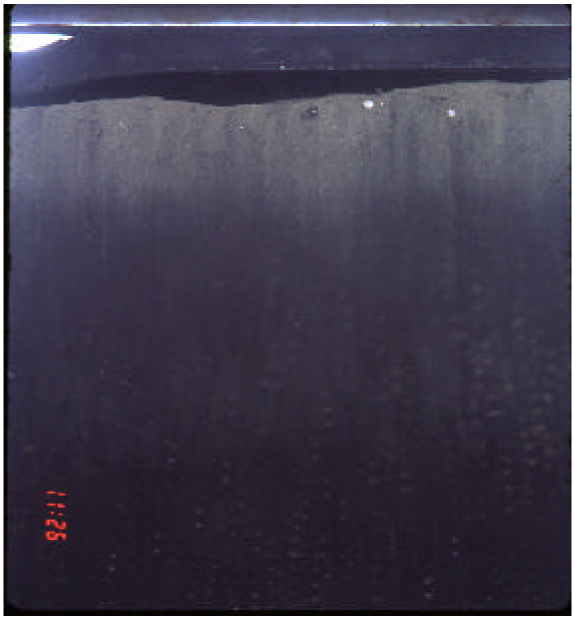


Figure 5-11a. Sediment Profile Image from Station 136 at Channel Inner Site.

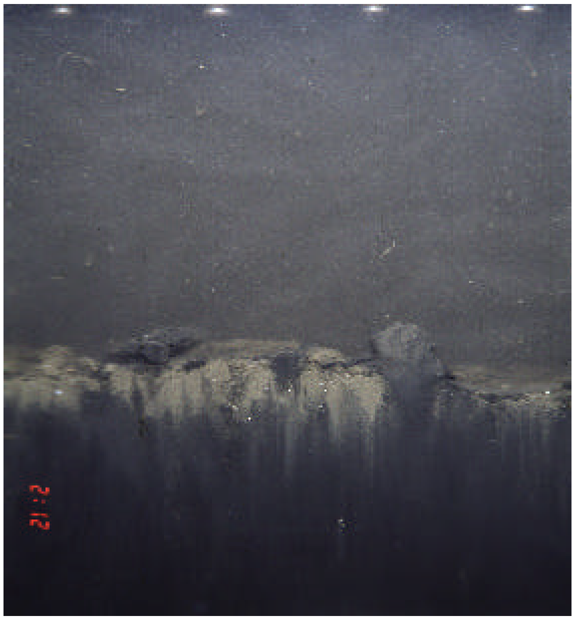


Figure 5-11b. Sediment Profile Image from Station 143 at Popes Island North Site.

5.3.2.3 Benthic Invertebrates

The benthic invertebrate fauna of the Massachusetts coast south of Cape Cod are characteristic of the Atlantic temperate biogeographical region, which has warmer temperatures and longer summer warming, and therefore a larger annual temperature range, than waters north of Cape Cod (the boreal ecoregion). Waters from Cape Cod south to Cape Hatteras, North Carolina lie within the Virginia Province of the American Atlantic Temperature Region. Many boreal species reach the southern limit of their range at Cape Cod, and it is there that many temperate species reach their northern range limit (Gosner, 1978).

Comprehensive benthic invertebrate sampling was not done, *per se*, at any of the candidate disposal sites. However, previous studies in the region (USEPA, 1996) contain some information on the abundance and type of benthos in New Bedford Harbor. Still other ancillary information was generated during other studies conducted for this project. For instance, REMOTS® sampling, conducted within New Bedford Harbor as part of this project, revealed general habitat conditions within or proximal to various candidate aquatic disposal sites within the ZSF, including the vicinity of the proposed preferred aquatic sites. The REMOTS® sampling survey did not identify or quantify the species of benthic fauna in New Bedford Harbor, rather, it provided evidence on the ecological roles of the present species, so that conclusions on community structure could be made (Refer to Section 5.3.2.2 - Benthic Habitat Conditions). Further site specific benthic investigation will be conducted within the preferred site footprints and this information will be included in the FEIR.

Based on information obtained from Mass GIS databases and information collected from ancillary studies for this project (e.g. habitat characterization via REMOTS® sediment profile imaging), various economically important benthic invertebrate species are expected to occur within New Bedford Harbor and, therefore, warrant attention for potential environmental impacts associated with UDM disposal in the Harbor (Table 5-6).

Table 5-6: Important Invertebrate Species of Economic Importance Warranting Attention in New Bedford Harbor from UDM Disposal Impacts

Common Name	***Scientific Name***
Quahog	*Mercenaria mercenaria*
Soft-shelled Clam	*Mya arenaria*
Bay Scallop	*Aequipecten irradians*
American lobster	*Homarus americanus*
Channeled Whelk (Conch)	*Busycon canaliculatum*

Source: Howes and Goehringer (1996)

The results of previous benthic invertebrate studies conducted in New Bedford Harbor by USEPA (1996) illustrate the composition of the benthic invertebrate community among the Upper, Lower and Outer Harbor areas. The Upper harbor is dominated by three species of invertebrates which are (in order of abundance): the marine polychaete worm *Streblospio benedicti* the dwarf surf clam, *Mulina lateralis*, and the gem shell *Gemma gemma*. The benthic community in many areas of this harbor segment is characterized by low evenness (i.e., unequal distribution of total individuals among the species present in the population) and low species richness (i.e., low total number of species when compared to other benthic invertebrate communities within the same faunal region)(USEPA, 1996). An average of 20 species per sampling station were identified in the Upper Harbor during systematic benthic invertebrate sampling. The Upper Harbor benthic invertebrate community was also found to be disturbed, using the EMAP Benthic Index metric (USEPA, 1995). The average EMAP benthic index of the Upper Harbor was found to be -5.7. A negative value indicates a disturbed community (either by natural or anthropogenic stresses). By comparison, a value of -2.7 was reported for the lowest 1 percentile of all sites measured in the Virginian Province. Based on the data collected, the USEPA (1996) study determined that the Upper Harbor benthic invertebrate community was highly impacted.

The benthic invertebrate community of the Lower Harbor segment is dominated by five invertebrate species which are (in order of abundance): the dwarf surf clam, *Mulina lateralis*; the marine polychaete worm *Streblospio benedicti*; an unidentified oligochaete; a capitellid threadworm polychaete *Mediomastus ambiseta* and the commercially important quahog, *Mercenaria mercenaria*. Species richness was comparatively higher in the Lower Harbor than the Upper Harbor with an average of 31 species identified per station in the Lower Harbor. Furthermore, the average EMAP benthic index (-1.4) suggested the Lower Harbor community to be impacted, but to a lesser degree than the Upper Harbor. However, within the Lower harbor, the benthic community within the limits of the Popes Island North Proposed Preferred Aquatic Disposal site was found to have a low index of community health (< -2.7). The EMAP Benthic Index for the Channel Inner site was determined to be moderate (i.e., between -2.7 and 0.0)(USEPA, 1996).

The Outer harbor had the highest species richness (an average of 72 species per station), the highest number of dominant species (16), and a positive average benthic EMAP index value (1.9), suggesting that the benthic invertebrate community was ecologically healthy. The assemblage of dominant species in the Outer Harbor represented additional taxa of marine invertebrates, some of which were not represented in the Lower and Upper Harbor communities. Examples include the gastropod molluscs, *Haminoea solitaria, Crepidula fornicata, Odostomia seminuda*; the cirratulid polychaete *Tharyx acutus*; the nephytid polychaete *Nephyts incisa*; the spionid polychaete *Scololepis texana*; the syllid polychaete *Parapionosyllis longicirrata*; and various pelecypod molluscs. Results of the ecological parameters measured in the USEPA (1996) study are summarized in Table 5-7.

Table 5-7: Ecological Parameters of the Upper, Lower, and Outer New Bedford Harbor Benthic Invertebrate Communities

Parameter	**Parameter Level**	**Upper Harbor**	**Lower Harbor**	**Outer Harbor**	**Comments**
Total benthic abundance	Species	Highly variable among individual grab samples			
Average total abundance	Species	3,612	2,435	2,295	Values are similar
Species richness	Population	lowest (20 ± 7 species per station)	intermediate (31 ± 14 species per station)	highest (72 ± 21 species per station)	Difference in values is statistically significant
Number of dominant species	Population	3	5	16	# of dominant spp. = those spp. that collectively account for 75% of total abundance for each benthic community
Average benthic EMAP index value	Community	-5.7 (-2.5 to -0.2)	-1.4 (-4.3 to -0.3)	1.9 (-0.2 to 4.8)	-2.7 reported for lowest 1 percentile in Virginian Province
Summation		Community highly impacted	Community impacted, but to lesser extent than Upper Harbor	Community healthy, as evidenced by high species richness and positive EMAP index	Ecological health of benthic invertebrate communities improves along a gradient from Upper Harbor to Outer Harbor

Average total abundance = count of each animal of every species, summed for all grabs taken from each benthic community

Source: (USEPA, 1996)

5.3.2.4 Commercially and Recreationally Harvestable Mollusks

DMF Mapping of New Bedford Harbor Shellfish

In Buzzards Bay, the primary shellfish fisheries are quahogs, scallops, soft-shelled clams, and conch. According to results presented in the 1996 Quahog Standing Crop Survey - New Bedford Inner and Outer harbors of the Commonwealth of Massachusetts, Whittaker (1996) concluded that the New Bedford/Fairhaven Harbor area and vicinity supports a substantial commercial quahog fishery. Quahogs are found throughout New Bedford Harbor and Buzzards Bay and are the dominant commercially and recreationally harvested shellfish species (Figure 5-12). However, all of New Bedford/Fairhaven Harbor waters north of the hurricane barrier are closed to shellfishing (DMF, 1999).

Despite this restriction, existing shellfish beds may still provide seed for cleaner areas, or could become fishable areas if pollutant concentrations were to be reduced in the future. Three such areas have been identified by the DMF for New Bedford/Fairhaven Harbor. They are identified as Shellfish Contaminated Relay Areas Nos. 1, 2, and 3, corresponding to Primary, Secondary, and Tertiary areas of priority respectively (Figure 5-13).

Priority Area No. 1 lies adjacent to the Seawall along the southwestern (New Bedford) shoreline of the lower harbor and extends easterly to the New Main navigation channel. It is bounded to the south by the Hurricane barrier and to the northerly to an area approximately equal to the end of the seawall. The northeastern corner of this relay area overlaps the southeastern corner of the Channel Inner Site.

Whittaker (1999) sampled the New Bedford Harbor and Acushnet River estuary complex in order to identify important shellfish resource areas. In the Whittaker report, sampling areas for shellfish overlapped potential dredge material disposal sites. For instance, at the sampling station (I-3) that overlaps the Popes Island North disposal site, samples of benthic biota were found to support a significant percentage (i.e., greater than 30%) of the cherrystone size class of the quahog, and a significant percentage (i.e., greater than 20%) of the littleneck size class of the quahog. The soft-shell clam was also found to be abundant at this location. Also, at the sampling location (I-5) that overlaps the Channel Inner dredge disposal site, samples of benthic biota were found to support a significant percentage (i.e., greater than 30%) of the cherrystone size class of the quahog, and a significant percentage (i.e., greater than 20%) of the littleneck size class of the quahog.

Priority Area No. 2 lies adjacent to the east side of the lower harbor along the Fairhaven waterfront from the hurricane barrier north to the Fairhaven Shipyard. It extends westerly to the main navigation channel. This priority area does not overlap any of the proposed preferred aquatic disposal sites.

Priority Area No. 3 lies adjacent to the south shore of Popes Island. It extends southerly to a point just south of Crows Island. It is bounded to the west by the New Bedford Reach of the main navigation channel and tp the east by the Fairhaven shoreline. This priority area does not overlap any of the proposed preferred aquatic disposal sites. Portions of the Popes Island North site lie within both quahog and mixed soft shell clam/oyster/quahog habitat, but outside of any Shellfish Contaminated Relay Areas.

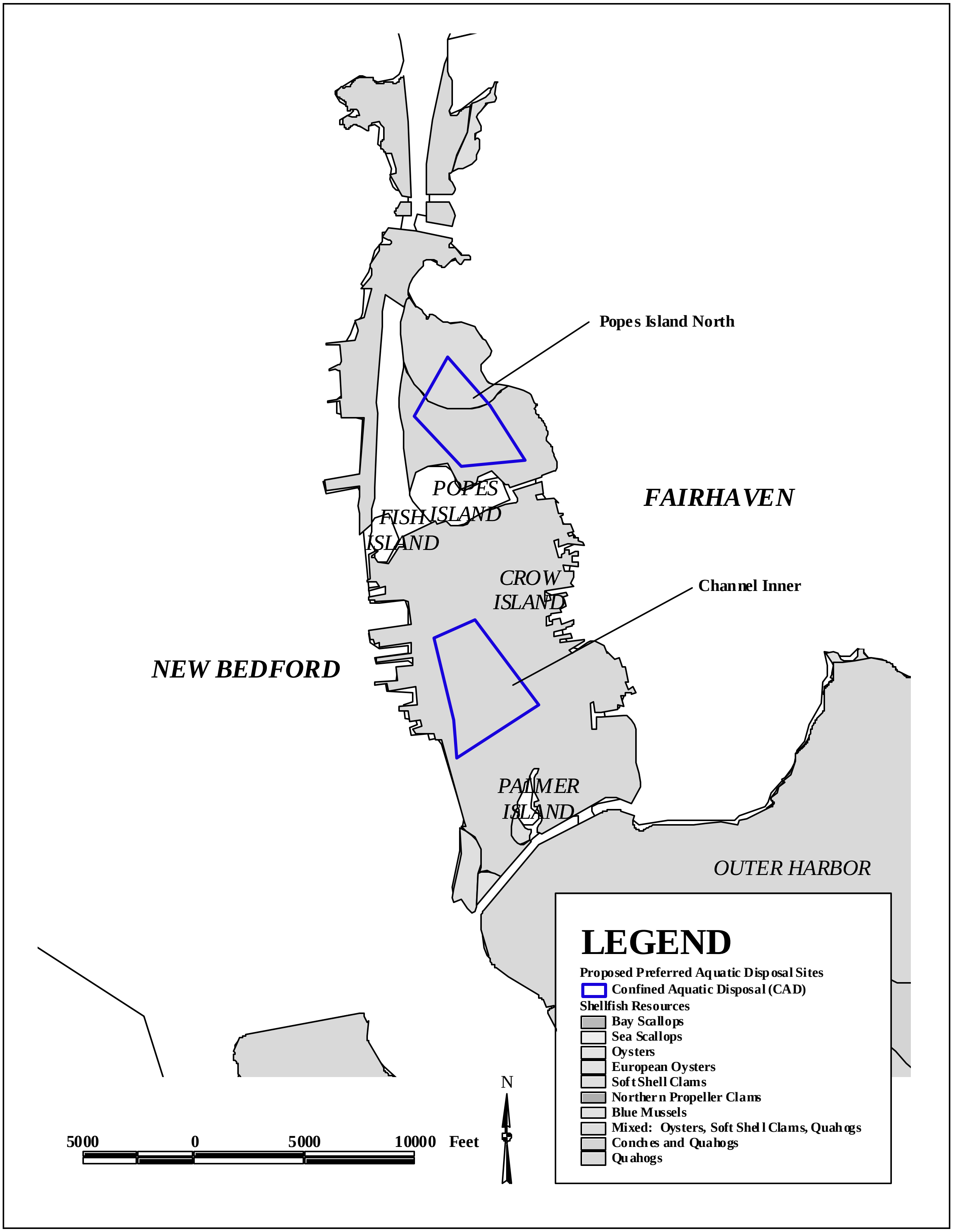


Figure 5-12: Shellfish Resources in New Bedford/Fairhaven Harbor

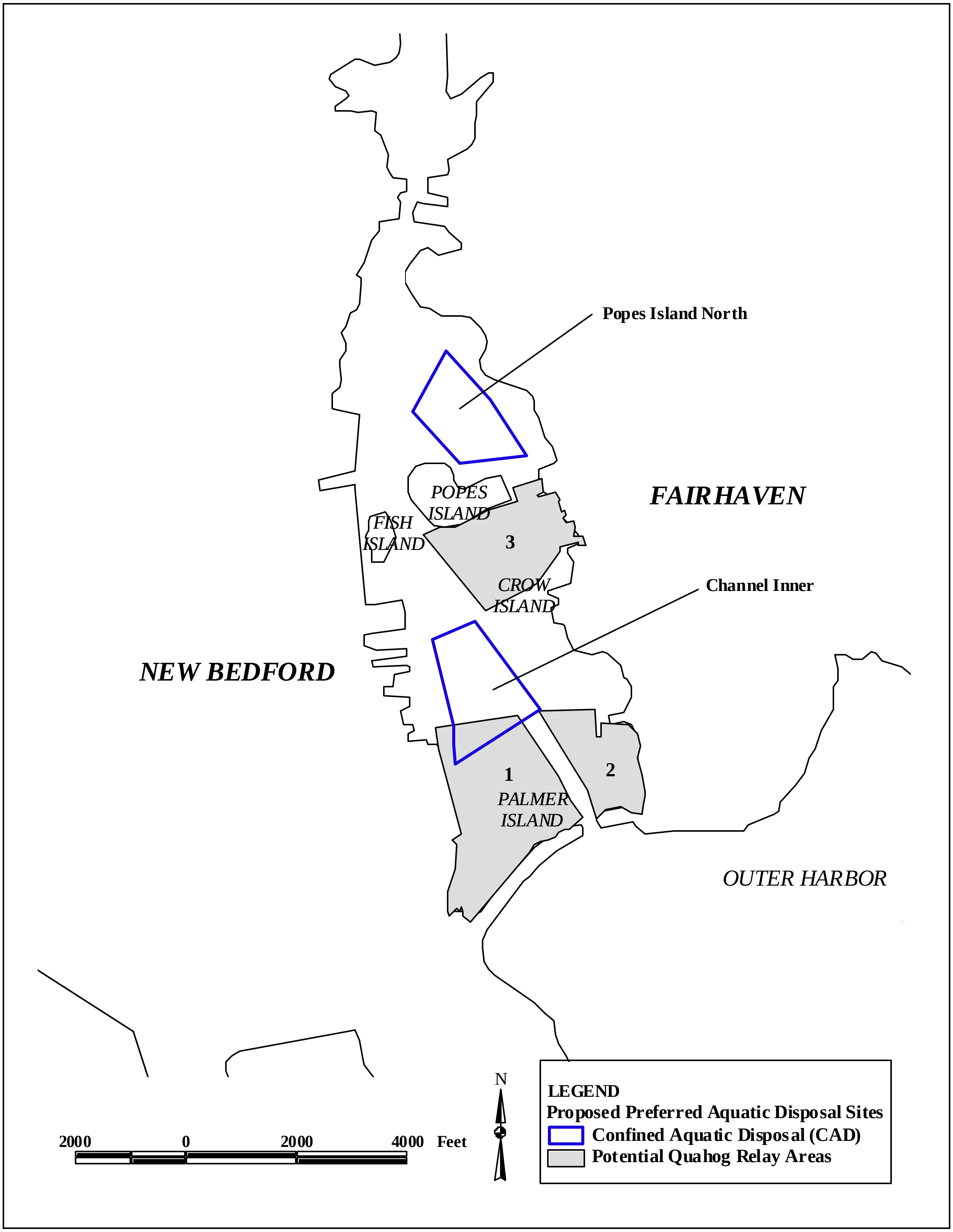


Figure 5-13: Potential Quahog Relay Areas

Sustainable Annual Quahog Yield

Whittaker (1999) predicted a continued decline in the quahog densities of "approved areas" within the Outer Harbor if present recruitment rates and market conditions remained the same or similar, and if harvesting continued at it's current rate. The average annual commercial landings currently reported for New Bedford/Fairhaven Harbor are almost equal to the potential harvest. This has caused a diminished catch per unit effort as indicated by Whittaker (1999). A contaminated relay program administered by DMF has also contributed to the reduction of the harbor's quahog standing crop. Whittaker also identified hydraulic harvesting as a potential impact to quahog settlement and growth due to the negative effects of sediment resuspension, subsequent deposition of silt and redistribution of the predominately mud substrate. Both Proposed Preferred Aquatic Disposal Sites overlap known quahog habitat. Sedimentation plumes generated during disposal may have a negative impact on larval dispersal, recruitment and development within these areas and within nearby approved harvesting areas.

The results of a Quahog resources survey for New Bedford and Fall River (NAI, 1999) revealed quahog densities similar to those reported in an earlier study (DeAlteris et. al., 1998) for tong sampling ($0.3/m^2$) and dredge sampling ($4.1/m^2$). Higher densities were found in Taunton River then in New Bedford. A trend of decreasing densities of smaller class sizes, especially the seed class, with distance down river was identified for the Taunton River, which was interpreted as an indication that upriver locations provide better habitat for seed quahogs.

Other Surveys

The results of the REMOTS® sampling did not identify benthic invertebrates to species level but did identify the successional stage of the benthic community. Within the area of the Lower Harbor sites (Channel -Inner and Popes Island North), REMOTS® sampling stations consistently revealed Stage I benthic community assemblages dominated by marine polychaetes. *Mulinia* shells were also noted at the Channel Inner site. An unidentified shell hash was found at the REMOTS® sampling station No. 143, on the east side of the Popes Island North site.

<u>5.3.2.5</u> <u>Lobsters</u>

Because all of the Harbor is closed to all fishing, including lobstering, the two Inner Harbor sites would have the lowest impact to lobster fishing of the New Bedford/Fairhaven Harbor region. Lobsters are abundant and the basis of productive fisheries in the New Bedford/Fairhaven Harbor and Buzzard's Bay regions. Since lobsters are mobile and are found throughout the region, it is difficult to differentiate among the Proposed Preferred Aquatic Disposal sites on the basis of their potential impact to adult lobsters. Surveys of the marine resources of the New Bedford/Fairhaven Harbor areas, while reporting on the overall importance of the lobster fishery to the area, do not specify which sites or areas are more productive than others. However, very young lobsters tend to be more stationary than older juvenile and adults. These lobsters, referred to as early benthic phase (EBP) lobsters, are more susceptible to dredged material disposal activities.

Although early benthic phase lobster survey data from New Bedford/Fairhaven Harbor was not available for this project, their preferred substrate is known to be hard substrate such as cobble and boulder areas (Palma et. al., 1998). Sediment profile images obtained from the Popes Island North site revealed soft, unconsolidated silty habitat, while images from the New Bedford Channel Inner site revealed unconsolidated soft-bottom silt or soft mud. Therefore primary EBP lobster habitat does not appear to occur within the Proposed Preferred Aquatic Disposal sites. Primary EBP lobster habitat most likely occurs around known rock reefs and other hard bottom substrates located in the Outer Harbor and further seaward into Buzzard's Bay (Figure 5-14). Considering lobster preferred habitat and habitat characteristics in the Lower Harbor, the lobster population in New Bedford's inner harbor is not substantial.

5.3.3 Finfish

Because of the mobility of fish, the characterization of fish species within a specific area, such as the Proposed Preferred Aquatic Disposal sites is difficult. However, several studies give insight into the types, patterns, and behavior of the dominant fish species in the Buzzards Bay region and New Bedford/Fairhaven Harbor. This information, coupled with what is known about environmental conditions at the Proposed Preferred Aquatic Disposal sites (e.g. substrate type, water quality, water depth), allows for a reasonable characterization of finfish at and near the preferred aquatic disposal sites.

This Section discusses the following aspects of finfish activity in the Buzzards Bay Region and New Bedford Harbor:

C Regional Finfish Profile (Buzzards Bay);
C Summary of New Bedford Harbor boat trawl and beach seine survey data (June 1998 - May 1999);
- Diadromous fish activity;
- Nursery Potential;
- Fish Spawning Potential; and,
- Commercial and Recreational Fishing.

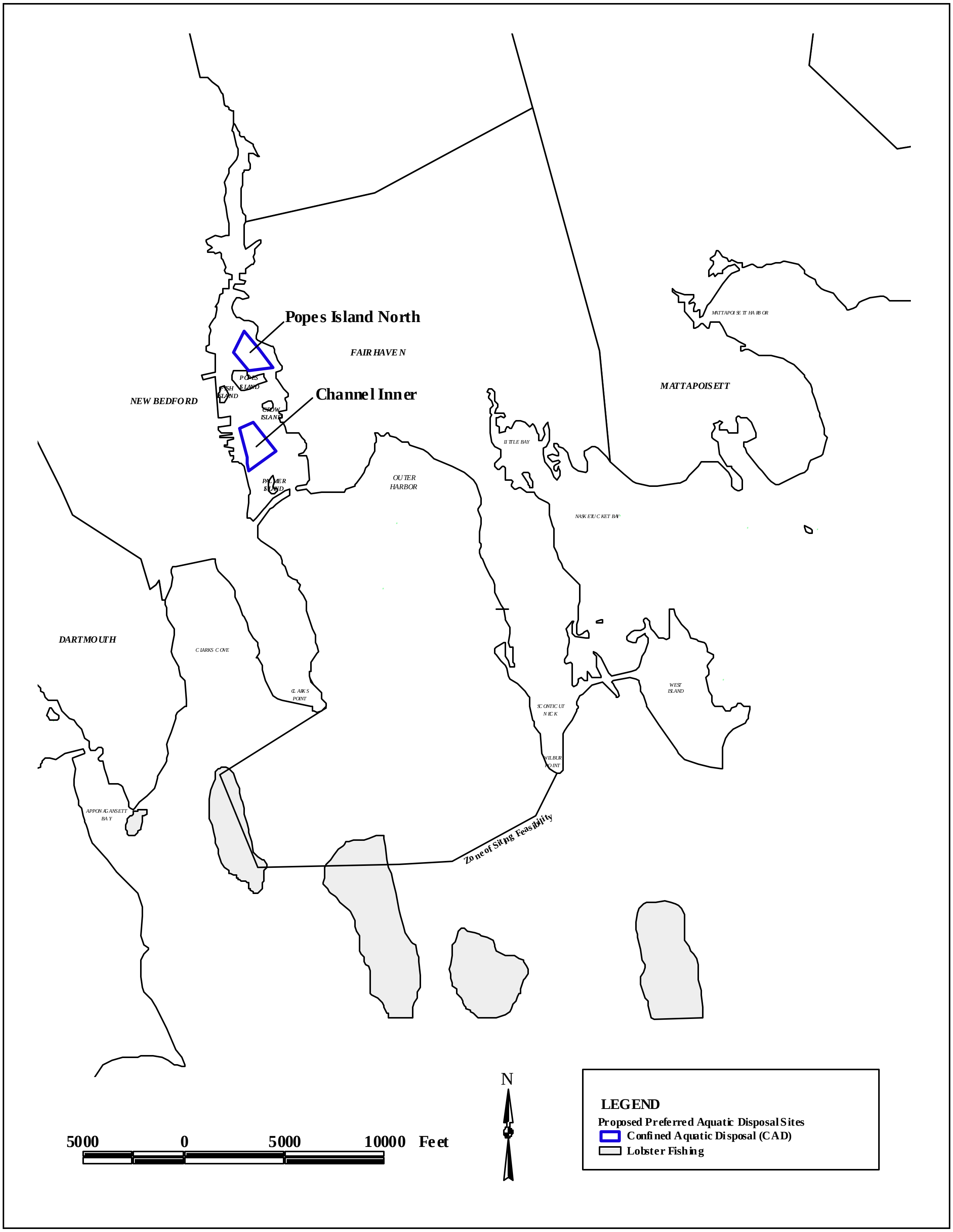


Figure 5-14: Lobster Fishing Areas

5.3.3.1 Regional Finfish Profile (Buzzards Bay)

As with the invertebrate fauna, the marine fish of New Bedford/Fairhaven Harbor are part of the Atlantic temperate biogeographical region. This region is characterized by moderate temperatures and longer summer warming, and therefore a wider annual temperature range than waters north of Cape Cod (the boreal region). Many northern species of fish reach the southern limit of their range at Cape Cod, and many southern species reach their northern range limit there as well.

Nearshore and deeper-water finfish populations within New Bedford/Fairhaven Harbor and vicinity have been the subject of various studies (Fiske et al. 1968; Giovani, 1973; Hoff and Ibara, 1977; Bellmer, 1988; EBASCO, 1990) the findings of which are summarized in the New Bedford Harbor Historic Overview Natural Resources Uses Status Report (VHB, 1996). Most studies reflect a subset of the finfish community reported for Buzzard's Bay by Stone et al. (1994). Howes and Goehringer (1996) reported 16 dominant fish species (Table 5-8) to inhabit Buzzard's Bay waters or associated salt marshes in the bay. Most of these species are also typical of New Bedford Outer Harbor waters, and many frequent the Inner Harbor as well. These species are identified as resident or non-resident (migratory) in Table 5-8.

Table 5-8: Dominant Fish Species Identified in Buzzards Bay (Howes and Goehringer, 1996)

Residents		Non-residents	
Common Name	**ScientificName**	**Common Name**	**Scientific Name**
Atlantic silverside	*Menidia menidia*	Alewife	*Alosa pseudoharengus*
Sheepshead minnow	*Cyprinidon variegatus*	Blueback herring	*Alosa aestivalis*
Atlantic herring	*Clupea harengus*	Atlantic menhaden	*Brevoortia tyrannus*
Winter flounder	*Pleuronectes americanus*	Tautog	*Tautoga onitis*
Mummichog	*Fundulus heteroclitus*	Black sea bass	*Centropristis striata*
Striped killifish	*Fundulus majalis*	Bluefish	*Pomatomus saltatrix*
Four-spined stickleback	*Apeltes quadracus*	Butterfish	*Peprilus triacanthus*
Scup	*Stenotomus chrysops*	Striped bass	*Morone saxatilis*

5.3.3.2 New Bedford Finfish Data

A complete record of finfish population trends in New Bedford Harbor is lacking due to prohibition of net fishing in the harbor waters nearly a century ago. The ban on net fishing eliminated catch records for this resource. Therefore, the MACZM and Normandeau Associates Inc (NAI) conducted a 12 month sampling study in New Bedford/Fairhaven Harbor waters between 1998 and 1999 to characterize the finfish population within the harbor during the cycle of seasons. The study consisted of the collection and analysis of seine and trawl samples collected from within the Inner and Outer Harbors. This sampling effort was coordinated with the Massachusetts Division of Marine Fisheries in order to be consistent with previous studies conducted by Fiske et al.(1968) and other previous sampling activities conducted in adjacent Buzzards Bay waters.

In the NAI study, all fish collected at each seine and trawl sample (Figure 5-15) were identified to species, counted, and measured for both total length to the nearest mm, and biomass to the nearest gram. Exceptionally large catches were estimated through volumetric sub-sampling, in which a minimum of twenty fish were measured. Ages of the fish were estimated based on their lengths. Catch data was analyzed by descriptive statistics, including mean, range and percent composition, to characterize seasonal and geographic features of the fish community in New Bedford/Fairhaven Harbor.

Seine Survey

Nearshore sampling locations consisted of a 50-foot seine with a 3/16 delta mesh, positioned parallel to shore in approximately 1 m of water and then directly hauled to shore covering a rectangular area. One seine sample was collected at each of the three sampling areas (Figure 5-15). Station NS1 was located in the south end of New Bedford near the ferry dock landing, while station NS2 was located to the east of Fort Phoenix on a shallow sandy beach. Station NS3 was located on the northeast side of Crow Island in the inner harbor. The resources were calculated as a Catch Per Unit Effort (CPUE) based on the number of fish per haul. Beach seine hauls attempted to cover equal distance, but hauls were not standardized to haul length.

Seine catches in New Bedford harbor were, at times, dominated by large catches of a few species. On a few sampling dates no fish were caught (January and February), due to fish moving to deeper waters. The most numerous fish captured by the seine was Atlantic Silversides (*Menidia menidia*), accounting for 44 % of the total catch at all seine sampling locations. Striped killifish comprised (16%), mummichog (9%), cunner (7%), and winter flounder (6%) of the fishes captured in nearshore New Bedford Harbor (Table 5-9).

CPUE of Atlantic silversides generally rose throughout the summer to a peak in abundance in August (Figure 5-16), primarily due to an increase in the capture of Young of Year (YOY, annual fry) fish. The CPUE started to decrease in December, no fish were caught in January and February, and began to increase thereafter. Striped killifish, which ranked second in CPUE, were most abundant, appearing in seine samples from July through December. Most of the captured striped killifish comprised of YOY fish (less than 40 mm) collected in September hauls. Mummichog ranked third in overall CPUE and were most common at sampling station NS2. The CPUE for mummichog peaked in August and were most common at sampling station NS2, which is in close proximity to a salt marsh. Mummichog are a common shore-zone fish in the Atlantic coast estuaries, and flooded salt marsh and mud flats are important habitats for foraging (Haplin1997; Javonillo 1997). At sampling station NS1 a large CPUE was documented for Atlantic Menhaden during the August sampling occasion.

Station NS2 yielded the largest geometric mean of CPUE for all three stations followed by NS1 and the lowest yielding station, NS3. On average the 'other species' categories accounted for approximately 18 % of the catch. This category included such fish as black sea bass, northern kingfish (*Menticirrhus saxatilis*), winter flounder and northern puffer (*Sphoeroides nephelus*). Based on the captured fish length, most of the species were considered YOY fish.

Table 5-9: Percent of fish caught in seine samples taken in New Bedford Harbor from June 1998 through May 1999.

Species	Station NS1 %	Station NS2 %	Station NS3 %	All Stations Combined (NS1-4) %
Atlantic Silverside	45.2	33.4	54.1	43.6
Striped killifish	11.1	19.1	14.0	16.0
Cunner	--	10.2	5.8	7.5
Mummichog	--	17.9	--	8.7
Atlantic Menhaden	11.2	--	--	--
Black sea bass	--	6.8	--	--
Winter flounder	--	--	11.7	6.3
Northern kingfish	--	--	3.2	--
Northern puffer	6.3	--	--	--
Bluefish	9.3	--	--	--
Other species	17	12.6	11.2	17.9
Total	100.1	100	100	100

Notes: -- = not determined for that species due to absence or extremely low abundance
(If present, included in numbers tallied as part of "other species" category)
Some totals do not equal 100% because of rounding

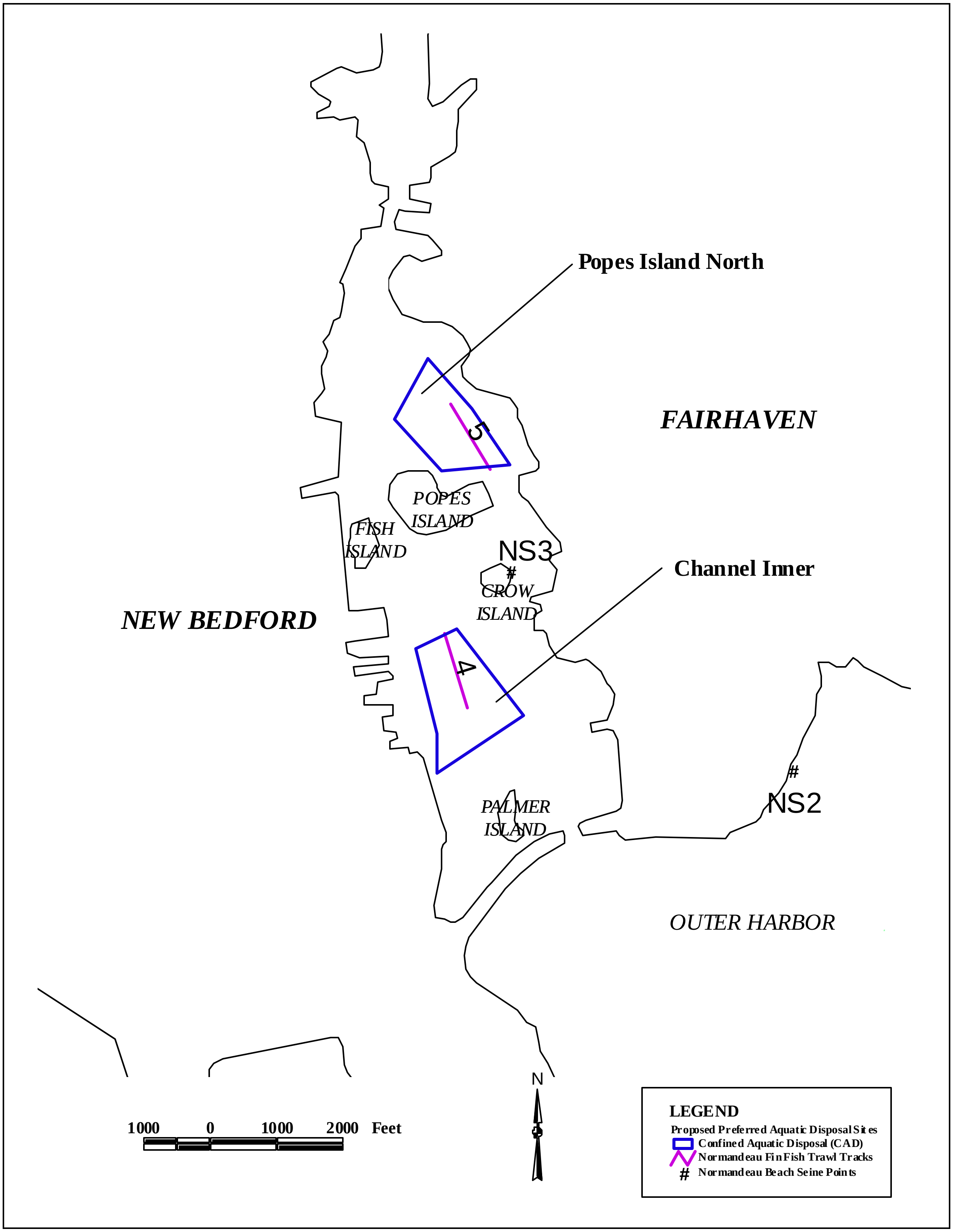


Figure 5-15: Beach Seine and Trawl Stations

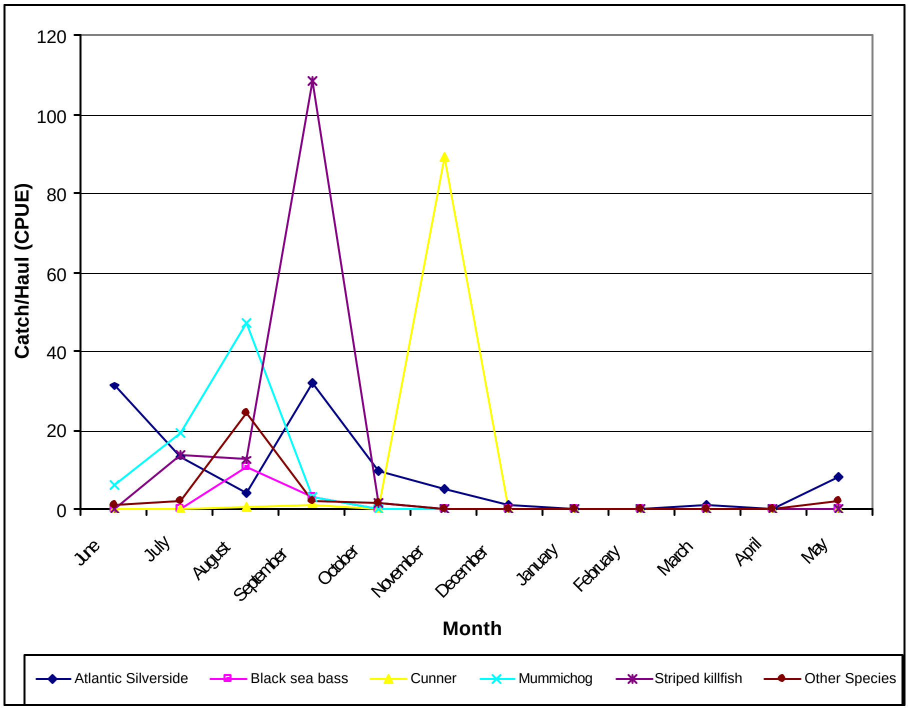


Figure 5-16: Geometric Mean Catch Per Unit Effort for Seine Samples in New Bedford/Fairhaven Harbor (NAI, 1999).

Trawl Samples

Deeper water sampling was conducted with a 30-foot trawl made of 2-inch stretch mesh in the body and 1-inch stretch mesh in the cod end with a 1/4-inch liner. Each trawl was towed for approximately 400 m. When a 400 m tow length was not achieved, the length and catch was standardized by the following mathematical equation.

$CPUE_{s,t} = (CATCH_{s,t}/TOW_t)\ 400$

where,

$CPUE_{s,t}$ = Catch per unit effort for species S in Sample T

$CATCH_{s,t}$ = Catch of species S in sample T

TOW_t = Tow length in m of sample T

The trawl catches characterized the fish community of depths from 6.5 to 33 feet (2 to 10 meters), within New Bedford Harbor. Trawl sampling locations are identified as NT1 through NT5 as shown in Figure 5-15. Sampling location NT1 was in outer harbor South End at a depth of 23 to 26 feet (7 to 8 meters). Station NT2 was also located in the Outer Harbor but north of the light house at a depth of 16.5 to 20 feet (5 to 6 meters). Sampling station NT3 was located in the Outer Harbor, but on the eastern side, at depths ranging from 23 to 26 feet (7 to 8 meters). Station NT4 was located in the Inner Harbor, to the east of the New Bedford docks, at depths between 26 and 29.5 feet (8 to 9 meters). Lastly, station NT5 was also located in the Inner Harbor, north of Popes Island at depths between 6.5 to almost 10 feet (2 to 3 meters).

Generally, the observations of the trawl catches were scup representing 23% of CPUE, cunner 21%, winter flounder 13%, black sea bass 9%, and northern pipefish 6% (NAI, 1999) (Figure 5-16). On a few occasions single large catches of a less abundant species affected the total annual catch statistics. Other species caught in substantial quantities were Atlantic herring (March, stations NT1 & NT4) and Atlantic silversides (December & March -station NT2, March - station NT3).

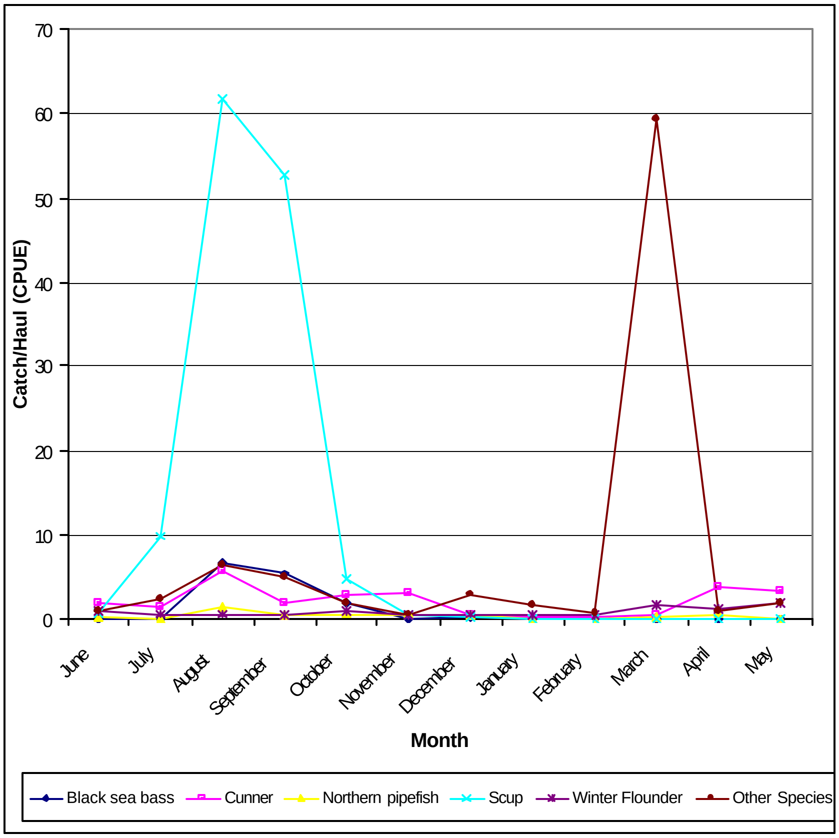


Figure 5-17: Geometric Mean Catch Per Unit Effort for Trawl Samples at Stations in New Bedford/Fairhaven Harbor.

Monthly CPUE steadily increased from May, peaked in August, and then decreased to a seasonal low in February as water temperatures decreased and the fish moved to deeper water (Figure 5-17). Highest CPUE occurred in August with scup dominating the catch. Recruitment of yong-of-the-year (YOY) of scup, cunner and black sea bass influenced the samples and reflected the seasonality of the deeper-water fish community.

Station NT1 ranked second among the five station in CPUE, and the sample consisted mainly of scup (Table 5-10). Black sea bass, cunner and northern pipefish comprised the remainder of the sample, however, these species were substantially less abundant than scup. The CPUE peaked in August and again rose significantly in March due to a large catch of Atlantic Herring. CPUE were low during the months of November through February and no fish were caught in November. YOY fish of Atlantic herring, scup, cunner and butterfish were present in the catches for most of the sampling events from March through October.

Table 5-10: Percent of fish caught in trawl samples taken in New Bedford Harbor from June 1998 through May 1999.

Species	Station NT1 %	Station NT2 %	Station NT3 %	Station NT4 %	Station NT5 %	All Stations combined (NT1-5) %
Atlantic herring	8.6	--	--	12.6	--	--
Atlantic silversides	--	10.3	8.7	--	8.1	--
Bay anchovy	--	--	--	--	6.5	--
Black sea bass	11.3	7.1	13.1	--	--	9.1
Butterfish	8.6	--	--	--	--	--
Cunner	10.7	34.0	30.1	18.2	--	20.8
Northern pipefish	--	4.6	--	13.4	--	6.0
Seaboard goby	--	--	--	--	9.5	--
Scup	35.3	25.3	26.8	17.3	--	23.4
Windowpane flounder	--	--	--	--	5.7	--
Winter flounder	--	--	6.2	11.5	52.5	12.5
Other species	25.5	18.7	15.3	27.1	17.8	28.2
Total	100	100	100.2	100.1	100.1	100

Notes: -- = not determined for that species due to absence or extremely low abundance
(If present, included in numbers tallied as part of "other species" category)
Some totals do not equal 100% because of rounding

Sampling station NT2, north of the lighthouse in the south end outer New Bedford harbor, ranked third among CPUE per station. The most common fish captured was cunner, with significant total catch yields from scup, Atlantic silversides, black sea bass, and northern pipefish. CPUE peaked in August at this sampling station due to the large numbers of scup, cunner and black sea bass. The CPUE decreased through October and few fish were caught in November. The CPUE was low through November to February, when no fish were caught. A significantly large catch of Atlantic silversides occurred in March and the CPUE steadily increased through July. Observed in the catches at this station were large amounts of *Codium spp.* and other red and green filamentous algae. At sampling location NT3, which was located in the east side of outer New Bedford harbor, the CPUE ranked fourth among the five stations. Here again, the catches were dominated by the cunner, scup, black sea bass, Atlantic silversides and winter flounder. Cunner were captured in every sampling event except during September. Young-of-Year fishes for the scup, cunner (except September), and black sea bass were observed in catches from June through October. Atlantic silversides were caught in January and March and the catch consisted of both YOY and yearlings. Winter flounder were captured in September and March through May, and catches comprised of both one year and older fish.

Located in the Inner Harbor, east of the New Bedford Docks was sampling station NT4, which was highest in CPUE for all stations. The high ranking was in part related to the large captures of Atlantic herring in March. Cunner were captured in each sampling event occurring April through November. The highest CPUE occurred in September, at this location, decreasing to near zero catches in February and increasing in March through August. YOY fish for cunner, scup Atlantic herring, and winter flounder were all recruited during many sampling efforts. Interestingly, the distribution of the species was fairly consistent and equal with no one species consistently dominating the catches. For the five species listed, the percentage of catch per species ranged between 11.5 % to 18.2 % and the other species category equaling 27.1%.

Sampling station NT5, which was located in the Inner Harbor consistently yielded the lowest CPUE of all sampling stations. The catches consisted of winter flounder (52%), followed by seaboard goby ([*Gobiosoma ginsburgi*], 9.5 %), Atlantic Silverside (8%), Bay anchovy ([*Anchoa mitchilli*], 6.5 %), windowpane flounder ([*Scopthalmus aquosus*], 5.75%) and other species comprised the remainder.
The fish species sampled in 1999 are typical of nearshore environments within Buzzards Bay.
For instance, the most common species sampled by Hoff and Ibara (1977) were also common in the NAI study. In addition, the most common fish captured in the NAI study were the silverside (*Menidia menidia*) and the mummichog (*Fundulus heteroclitus*). These results were similar to the monthly pattern of abundance reported for the Slocum River estuary (Hoff and Ibara, 1977), which is located approximately 10 km SW of New Bedford/Fairhaven Harbor. Findings reported for a similar study in the Westport River (Fiske et al, 1968) were similar to the findings reported in the NAI study for New Bedford (NAI, 1999). One species, the cunner (*Tautogolabrus adspersus*), is repeatedly observed in both the nearshore and deeper-water sampling efforts of various studies.

5.3.3.3 Diadromous Fish Activity

Four species (alewife, American shad, blueback herring, rainbow smelt) are diadromous in the Buzzards Bay area. Anadromous fish are those that migrate from the sea to breed in fresh water. Diadromous fish are those that, at any particular life stage, regularly move between freshwater and saltwater, spending part of their life cycle in each environment. The Acushnet River supports an annual anadromous fish run of Alewife, which spawn in Sawmill pond, generally beginning in March/April and continues into June (Howes and Goehringer, 1996). Other anadromous and diadromous species known to utilize Buzzard Bay waters are the Blueback herring, striped bass (*Morone saxatalis*), white perches (*Morone americana*), and rainbow smelts (*Osmerus mordax*).

Recent finfish sampling in New Bedford Harbor has provided current data on diadromous fish activity within the New Bedford Harbor/Acushnet River estuary (NAI, 1999). Alewife were found to appear in trawl samples collected from the harbor in September, but were absent in other months. Trawl sampling also revealed that significant rainbow smelt runs occur in the harbor in the early spring and then again in summer, with peak densities occurring in March and July. White perch were found to occur in New Bedford Harbor waters solely in March. American shad and blueback herring were not caught in either seine or trawl samples collected from New Bedford Harbor during NAI finfish sampling efforts (NAI, 1999).

5.3.3.4 Nursery Potential

Certain intertidal and subtidal habitats are favorable for finfish nurseries because they provide areas for cover, feeding, and development. For instance, salt marsh (intertidal) and subtidal eelgrass (*Zostera marina*) habitats provide nursery habitat for numerous fish species. Certain other benthic substrate conditions outside of salt marsh or eelgrass areas can also be good nursery habitat. Therefore, the presence of these habitats to the finfish resources of New Bedford/Fairhaven Harbor is discussed below. Using the sediment profile imagery data collected for this project, the nursery potential of the Proposed Preferred Sites is evaluated as well.

The various subtidal and intertidal habitats with nursery potential are an important part of the ecology for New Bedford/Fairhaven Harbor and other communities within Buzzards Bay. These habitats generally occur around the perimeter of the embayment, although in some areas they have been dramatically altered or eliminated by development. New Bedford/Fairhaven Harbor has the smallest amount of salt marsh area due to large scale development and physical structure of the harbor (Howes and Goehringer, 1996). Therefore, the remaining intertidal and subtidal benthic substrates identified as having a high nursery potential are important resource areas to the harbor's finfish community.

Both resident and non-resident species inhabit these areas and represent an important element in the ecological web of both the harbor and Buzzards Bay. Most resident fish species spend their entire life within these habitats and, therefore, within the waters of New Bedford/Fairhaven Harbor. Non-resident adult species enter these habitats to spawn, and juveniles of other species use these habitats only as nursery grounds. Typical resident species include the Atlantic silverside, which generally live for only one year. Those that do survive migration to deeper warm waters in the winter, and return to nearshore nursery areas to spawn in the spring.

Three species of killifish are typical residents of the salt marsh. These fish usually winter in the lower sandier areas of the marsh. Spawning generally occurs between April and October. Mummichogs are also marsh residents. Typically, these fish will live several years and winter by burrowing or clinging to the bottom of creeks and marsh pools in brackish waters (Howes and Goehringer, 1996). All resident species may susceptible to impacts associated with UDM management since they may be exposed to UDM activities for a long duration, and throughout various stages of their life cycles. Exposure to contaminated sediment during larval and juvenile development may have health implications for all species during later life stages.

Non-resident species include bay anchovy, sheepshead minnow, striped mullet (*Mugil cephalus*), northern pipefish, butterfish, black sea bass, cunner, American eel (*Anguilla rostrata*), and sand lance (*Ammodytes americanus*). Non-resident species growth rate in the salt marsh is almost 10 times the rate of the residents. An investigation of the gut contents of residents and non-residents were consistent with the observed growth rates. The non-resident species maintained a higher feeding rate and consumed a higher percentage of animal foods than residents (Howes and Goehringer, 1996). Although non-residents may spend less time within the estuaries, they may not necessarily be less susceptible to impacts associated with UDM disposal. Their higher feeding rates and higher percentage consumption of animal foods may make them more susceptible to toxic effects of sediment contaminants. As developing larvae or juveniles in a nursery, they may be highly susceptible to certain toxicants. This exposure also represents a potential pathway to impact to areas outside of the harbor, should these fish leave the estuarine nursery for offshore adult habitats.

Utilizing the information from the DMMP Seine and Trawl Surveys (NAI, 1999), REMOTS® survey (Valente, 1999), and other literature, the potential value for the Preferred Aquatic Disposal Sites as a nursery for finfish and large invertebrates was assessed. UDM disposal is more likely to affect sensitive larval and juvenile stages of fish and invertebrates, so the protection of areas with high nursery potential is important. Nursery potential is estimated using the following empirical formula (Wilbur, 1999):

HABITAT COMPLEXITY + JUVENILE PRESENCE = NURSERY POTENTIAL (HIGH, MODERATE, LOW)

Habitat complexity (1-12) is highest where there is variation in substrate conditions and greatest vertical structure. Juvenile presence (yes/no) is the dominant commercial, recreational and non-target organism collected in substantial numbers or apparent in similar habitat.

All New Bedford Harbor candidate aquatic disposal sites were determined to have moderate to high nursery potential for juvenile fish. Beach seine and open water trawl sampling conducted within New Bedford Harbor (NAI, 1999) revealed that many areas of the harbor are important finfish nursery areas. For instance, the Inner Harbor was found to be an important nursery area for winter flounder, while deeper water areas of the Outer Harbor were found to provide nursery for scup, cunner, and black sea bass.

5.3.3.5 Spawning Potential

Spawning periods for the most common fish and invertebrates within a given area are commonly used as a model for assessing overall marine fish spawning potential for that area. In fact, dredging is often limited to the times of year of decreased spawning, which is typically winter to spring. Many local surveys have identified important habitat associations (sand and cobble, eelgrass) that appear to be essential for the reproduction and development of fishes and invertebrates. Spawning potential within and proximal to the Proposed Preferred Aquatic Disposal Sites was estimated during this assessment based on available information obtained on substrate types, complexity, and water quality. The New Bedford Channel Inner and Popes Island North sites were determined to provide suitable spawning habitat for several fish species. Spawning activity at these sites is highest from May to September, and diadromous fish runs are present at particular times of the year.

New Bedford may support spawning winter flounder, since young of the year juveniles were found to co-dominate catches per unit effort during recent sampling (NAI, 1999), and the substrate types (mud to sand or gravel), depths (0.3 - 4.5m), temperature (3 - 5ºC), and salinity (10-32 ‰) regimes required by this species for spawning (Pereira, et al., 1999) occur within the harbor.

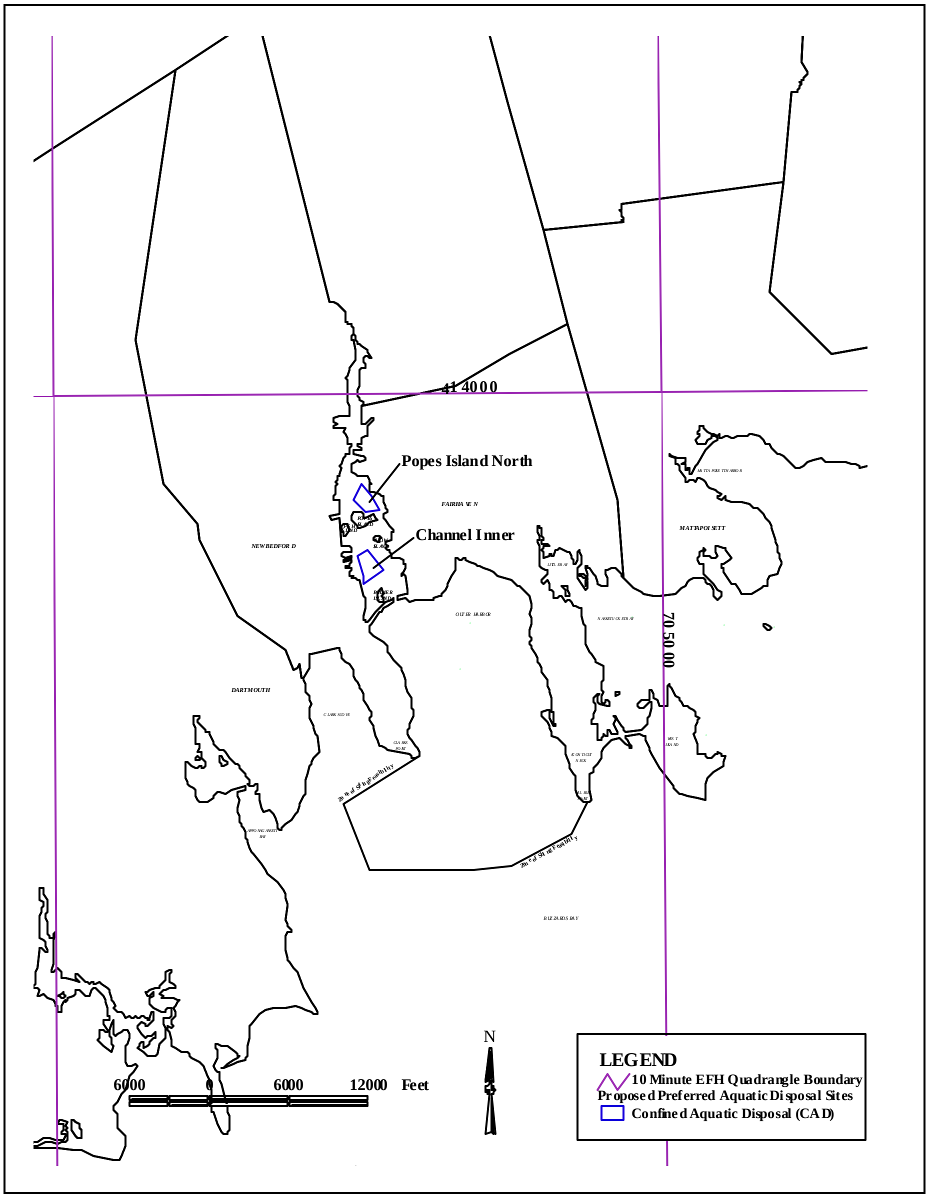
The seasonality of spawning for the dominant fish and invertebrates is an important factor in planning UDM disposal. For instance, dredging and disposal restrictions are imposed by DEP for Massachusetts coastal waters to protect the spawning activities of dominant finfish species within the region. Spawning for most of these organisms occurs in the spring, summer and early fall. As such, dredging has historically been limited to the late fall and winter season to protect spawning activities. The imposition of seasonal restrictions avoids impacts to sensitive eggs and larvae within the water column (pelagic) and on the seafloor (demersal).

Essential Fish Habitat (EFH)

The Magnuson-Stevens Act of 1976 (the Act) was passed in order to promote fish conservation and management. Under the Act, the National Marine Fisheries Service (NMFS) was granted legislative authority for fisheries regulation in the United States within a jurisdictional area located between three miles to 200 miles offshore, depending on geographical location. NMFS is an agency within the National Oceanic and Atmospheric Administration (NOAA) within the United States Department of Commerce (American Oceans, 2001). The NMFS was also granted legislative authority to establish eight regional fishery management councils that would be responsible for the proper management and harvest of fish and shellfish resources within these waters. Measures to ensure the proper management and harvest of fish and shellfish resources within these waters are outlined in Fisheries Management Plans prepared by the eight councils for their respective geographic regions. New Bedford/Fairhaven Harbor lies within the management jurisdiction of the New England Fisheries Management Council (NEFMC).

Recognizing that many marine fisheries are dependent on nearshore and estuarine environments for at least part of their life cycles, the Act was reauthorized, and changed extensively via amendments in 1996. The amendments, among other things, aimed to stress the importance of habitat protection to healthy fisheries. The authority of the NMFS and their councils was strengthened by the reauthorization in order to promote more effective habitat management and protection of marine fisheries. The marine environments important to marine fisheries are referred to as Essential Fish Habitat (EFH) in the Act and are defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." To delineate EFH, coastal littoral and continental shelf waters are mapped and superimposed with ten minute by ten minute square coordinate grids (ten minute grid). New Bedford/Fairhaven Harbor lies within portions one 10Nx10N grid areas designated as EFH for the New England Groundfish Management Plans (Figure 5-18).

All economically important fish species in which NFMS has determined will find suitable habitat within the ten minute grid are listed as EFH species. The habitat within a given ten minute grid must be essential to one or more life stages of the species, for the species to be listed as EFH to that coordinate. Within the designated grid for New Bedford/Fairhaven Harbor (including portions of Buzzards Bay), EFH for 20 species are designated within the established ten minute grid (Table 5-11). As part of the DMMP an EFH Assessment was conducted and is included in Appendix F.



10'' x 10'' Square Square Coordinates:

Boundary	***North***	***East***	***South***	***West***
Coordinate	41E/ 40.0'' N	70E/ 50.0'' W	41E/ 30.0'' N	71E/ 00.0'' W

Square Description (i.e. habitat, landmarks, coastline markers): Waters within Buzzards Bay within the Atlantic Ocean within the square affecting the following: south of Dartmouth, MA., New Bedford, MA., and Fairhaven, MA., from Sconticut Neck and the western part of West Island to Slocum Neck and Barney''s Joy Point in Dartmouth, MA. Also affected are: Wilkes Ledge Mishaum Pt., Round Hill Pt., Smith Neck, Dumpling Rocks, Negro Ledge, Great Ledge, Phinney Rock, Pawn Rock, White Rock, Hussey Rock, Apponagansett Bay, Ricketson Pt. in South Dartmouth, MA., Apponagansett, MA., Clarks Cove, Clarks Pt., in Fairhaven, MA., Butler Flats, Mosher Ledge, Wilbur Pt. on Sconticut Neck, Bents Ledge, Middle Ledge, and West Ledge. These waters are also within western Nasketucket Bay, east of Sconticut Neck and north of West I., and within New Bedford Harbor.

Figure 5-18: EFH Ten Minute Grid for New Bedford/Fairhaven Harbor (NOAA,NMFS)

Table 5-11: New Bedford/Fairhaven Harbor EFH Designated Species

Species	***Eggs***	***Larvae***	***Juveniles***	***Adults***
Atlantic cod *(Gadus morhua)*	X	X	X	X
haddock *(Melanogrammus aeglefinus)*	X	X		
pollock *(Pollachius virens)*				
whiting *(Merluccius bilinearis)*				
offshore hake *(Merluccius albidus)*				
red hake *(Urophycis chuss)*		X	X	X
white hake *(Urophycis tenuis)*				
redfish *(Sebastes fasciatus)*	n/a			
witch flounder *(Glyptocephalus cynoglossus)*				
winter flounder *(Pleuronectes americanus)*	X	X	X	X
yellowtail flounder *(Pleuronectes ferruginea)*				
windowpane flounder *(Scopthalmus aquosus)*	X	X	X	X
American plaice *(Hippoglossoides platessoides)*			X	X
ocean pout *(Macrozoarces americanus)*				
Atlantic halibut *(Hippoglossus hippoglossus)*				
Atlantic sea scallop *(Placopecten magellanicus)*				
Atlantic sea herring *(Clupea harengus)*			X	X
monkfish *(Lophius americanus)*				
bluefish *(Pomatomus saltatrix)*			X	X
long finned squid *(Loligo pealei)*	n/a	n/a	X	X
short finned squid *(Illex illecebrosus)*	n/a	n/a		
Atlantic butterfish *(Peprilus triacanthus)*	X	X	X	X
Atlantic mackerel *(Scomber scombrus)*	X	X	X	X
summer flounder *(Paralicthys dentatus)*	X	X	X	X
scup *(Stenotomus chrysops)*	X	X	X	X
black sea bass *(Centropristus striata)*	n/a	X	X	X
surf clam *(Spisula solidissima)*	n/a	n/a	X	X
ocean quahog *(Artica islandica)*	n/a	n/a		
spiny dogfish *(Squalus acanthias)*	n/a	n/a		
tilefish *(Lopholatilus chamaeleonticeps)*				
king mackerel *(Scomberomorus cavalla)*	X	X	X	X
Spanish mackerel *(Scomberomorus maculatus)*	X	X	X	X
cobia *(Rachycentron canadum)*	X	X	X	X
sandbar shark *(Charcharinus plumbeus)*				X
bluefin tuna *(Thunnus thynnus)*			X	

Source: NOAA, NMFS

5.3.3.6 Commercial and Recreational Fish Harvest

Commercial gill net fishing and lobstering is practiced outside New Bedford/Fairhaven Harbor in Buzzards Bay and distant off-shore areas such as the Nantucket and Georges Fishing Banks. Since the Proposed Preferred Aquatic Disposal Sites lie within New Bedford/Fairhaven Harbor, both of the aquatic disposal sites are within areas closed to mobile gear fishing (e.g. trawls, seines, dredges). New Bedford/Fairhaven Harbor is important to commercial fishing as a landing port. Fish landings for New Bedford, MA in comparison to Massachusetts statewide landings are provided in Table 5-12. Approximately 99% of the total poundage of scallops landed in Massachusetts ports in 1999 were landed in New Bedford. About ninety-one (90.8%) percent of all window pane flounder poundage landed in Massachusetts came into New Bedford Harbor in 1999. Eighty percent (80%) of all winter flounder landed in Massachusetts came into New Bedford Harbor. A majority of the total yellow-tailed flounder (70.6%) and monkfish (66.5%) landed in Massachusetts in 1999 occurred in New Bedford. Most of the landings are from offshore fishing grounds.

Lobstering is practiced in deeper waters nearly year-round, including fall and winter months when dredging and disposal would occur. Coastal lobstering is most intensive from May to November (Estrella and Glenn, 2000). Because of their mobility and natural changes in environmental conditions from season to season and year to year, the location of good lobster grounds can vary at any time. However, the anecdotal information given above does indicate some general differences in lobstering between in-shore and off-shore areas.

Summarized below are dominant finfish species observed in Buzzards Bay waters, including New Bedford harbor. The description includes a short narrative of the species habits and whether or not the fish species is a significant commercial resource, recreational resource, or both.

Scup (*Stenotomus chrysops*)

Scup, also known as "porgy" are residents and typically the most abundant finfish throughout the summer and into the early fall. They are most common in the Lower and Outer Harbors (EBASCO, 1990). These fish are both an important recreational and commercial resource in the region and are prey for cod, bluefish, and weakfish (Steimle, et al., 1999a). During the winter these fish migrate to deeper warmer waters and return to in-shore regions (estuaries) in the spring to spawn. Peak spawning usually occurs in June (Bigelow and Schroeder, 1953). These fish are primarily bottom feeders existing on small crustaceans, worms, mollusks, squid and occasionally small fish (Steimle, et al., 1999a). Scup appear to be temperature sensitive; sudden decreases in temperature occurring in late fall have been identified as a major contributor in mortality in bays and estuaries in the embayment (Clayton et al., 1978). Results of finfish sampling conducted in New Bedford Harbor (NAI, 1999) revealed that scup typically appear within the harbor from June to December, with peak densities occurring from late July through early September. As bottom feeders, scup may be indirectly impacted by the loss of their benthic invertebrate prey during UDM dredging, CAD excavation, UDM disposal, and final CAD capping. Dredging and disposal activities within the Lower and Outer Harbors may disrupt spawning and subsequent young of year may be susceptible to physical disturbances related to sediment disposal at a Lower Harbor CAD site. As a result, local scup densities may decline in the vicinity of the disturbance areas.

Alewife (*Alosa pseudoharengus*)

Alewife are anadromous non-residents of the Buzzards Bay waters. They return each year with regularity and are important both as a recreational and commercial resource. This finfish resource has a substantial number of early laws and regulations in the Commonwealth of Massachusetts statutes designed to protect the fishery. The alewives return to their freshwater spawning grounds beginning in late April to early May. During migratory movements, they may be common throughout all the major regions of the New Bedford/Fairhaven Harbor (EBASCO, 1990). The young typically spend their early stages in the ponds, and as early as July, migrate out to the estuaries to spend their first year (Cooper, 1961). The diet of the alewife mainly consists of copepods, shrimp, eggs and larvae (Howes and Goehringer, 1996). The mean catch per unit effort (catch per haul) for Alewife captured during finfish trawl sampling within New Bedford Harbor was greatest in September (NAI, 1999). Turbidity produced during UDM dredging, CAD excavation, UDM disposal, and final CAD capping may block the migratory movements of alewife within the Acushnet River. These fish may also be subjected to physical impairment (e.g., turbidity-induced clogged gills resulting in suffocation, or abrasion of sensitive epithelial tissue) as they pass through turbid waters. As a result, seasonal alewife densities may temporarily decline within the river. Although alewife is not an important recreational or commercial finfish species, it is a prey item for some commercially and recreationally important finfish. Therefore, a decrease in alewife densities may impact the populations of these predator species.

Blueback herring (*Alosa aestivalis*)

Blueback herring are closely related to alewives and, like alewife, are also anadromous, usually entering the brackish waters by mid-May to spawn. The blueback or ‘river herring’ tend to be more salinity tolerant and do not depend on the freshwater nursery habitat as much as alewives (Chittenden, 1972; Clayton et al., 1978). The diet of the blueback herring consists of copepods, pelagic shrimp, fish eggs and larvae (Howes and Goehringer, 1996). Both the alewives and the blueback herring are an important prey source for many other species of fish, most notably the bluefish and the striped bass. Turbidity produced during UDM dredging, CAD excavation, UDM disposal, and final CAD capping may block or disrupt the migratory movements of blueback herring within the Acushnet River. These fish may also be subjected to physical impairment (e.g., turbidity-induced clogged gills resulting in suffocation, or abrasion of sensitive epithelial tissue) as they pass through turbid waters. Turbidity plumes within the water column may also impact the visual-based feeding efficiency of this species, since their prey consists of various organisms that inhabit the water column. Although blueback herring is not an important recreational or commercial finfish species, it is a prey item for some commercially and recreationally important finfish. Therefore, a decrease in blueback herring densities may impact the populations of these predator species.

Atlantic menhaden (*Brevoortia tyrannus*)

Atlantic menhaden are a commercially important resource, primarily used for fish meal and oils rather than direct human consumption. These non-residents spawn both at sea and inshore waters generally between April and October (Howes and Goehringer, 1996). Sampling within New Bedford Harbor (NAI, 1999) revealed menhaden to be most abundant in August. The diet of these fish is predominantly phytoplankton, smaller crustaceans, and various larvae (Howes and Goehringer, 1996). These fish are also an important prey species for most carnivorous marine fish. Since this species spawns in both inshore and of shore waters, offshore populations of menhaden may avoid the disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, inshore populations may be subjected to the same impacts as described for blueback herring. Although menhaden are not an important recreational or commercial finfish species, it is a prey item for some commercially and recreationally important finfish. Therefore, a decrease in menhaden densities may impact the populations of these predator species.

Striped bass (*Morone saxatalis*)

Striped bass are another anadromous fish which typically spawn in Chesapeake Bay waters. These fish typically migrate up from their spawning waters and inhabit the inshore areas including brackish rivers. These non-residents, like bluefish, are very aggressive feeders. Their diet consists of fish and invertebrates such as squid, herring smelts, menhaden, alewives, shrimp, lobsters, crabs, and polychaetes. Striped bass usually are summertime residents of the embayment. However, reports of the fish overwintering in some of the rivers of southern Massachusetts have been reported. The striped bass are one of the most important recreational species in the Buzzards Bay waters. They are most abundant in New Bedford Harbor in July and October (NAI, 1999).

As a highly mobile species, striped bass may avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, given their propensity for spawning in estuarine habitats, this species may be subjected to physical impairment (e.g., turbidity-induced clogged gills resulting in suffocation, or abrasion of sensitive epithelial tissue) as they pass through turbid waters to and from spawning areas. Avoidance of the disturbance areas, failed spawning, and loss of individuals due to physical impairment could impact the local population of this species, thereby, effecting the local recreational and commercial harvest of this species for the year.

Winter flounder (*Pleuronectes americanus*)

Winter flounder are considered residents of the embayment and are both a commercially and recreationally significant resource, even after serious declines in the populations (Howes and Goehringer, 1996). The reason(s) for decline in the population is still unclear, however, the fishes' habit of burrowing into the sediments increases its potential exposure to many pollutants compared to other species that live within the water column. The habit of burrowing is thought to result in a higher incidence of fin rot and hepatic carcinomas in pollutant impacted areas (Landahl, et al., 1990; Johnson, et al., 1992). The fish are believed to return to the estuaries of their origin for spawning (Saila, 1961). Young winter flounder tend to remain within the embayments during their first year and move out into more open waters during the summer months, returning to the inshore areas in the fall. Actual spawning usually occurs in February and March. Peak abundances captured per sampling effort within New Bedford Harbor were recorded in May and June (NAI, 1999). The diet of the winter flounder is primarily comprised of worms, bivalves, crustaceans, snails and mollusks (Pereira, 1999).

This species may be the most susceptible to direct impacts associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping due to their demersal life styles. Compared to pelagic finfish, demersal fish species such as winter flounder are more susceptible to UDM dredging and disposal since most dredging related disturbance occurs near the bottom. The demersal eggs of the winter flounder are highly susceptible to impacts of dredging as compared to species with planktonic eggs. The eggs and larvae of species with demersal eggs may be killed from exposure to elevated concentrations of suspended solids and associated water quality impacts. The cumulative effects of UDM dredging, CAD excavation, UDM disposal, and final CAD capping may have a substantial impact to the winter flounder population of the New Bedford/Fairhaven Harbor. To the extent that winter flounder from New Bedford/Fairhaven Harbor fail to recruit to other areas of Buzzards Bay, the regional recreational and commercial harvest of this species may also be impacted.

Black sea bass (*Centropristis striata*)

Black sea bass is considered a non-resident species in New Bedford/Fairhaven Harbor, migrating to the Harbor and Buzzards Bay waters in the summer, then retreating to warmer, deeper waters in winter (Howes and Goehringer, 1996). The juveniles are born as females and after the first spawn transform to males, they utilize the Buzzards Bay waters as a nursery ground, appearing in New Bedford harbor from August to December, with peak densities occurring in either August or September. The immature black sea bass are bottom feeders existing mainly on mysids in shallow areas, while the adult black sea bass diet consists of crustaceans, mollusks and fish (Steimle, et. al., 1999b). The adult fish are sought after by both commercial and recreational fishermen.

Black sea bass may avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, as bottom feeders, this species may be indirectly impacted by the loss of their benthic invertebrate prey during UDM management activities. In response to the loss or decline of their invertebrate prey, black sea bass densities may decline in the vicinity of the disturbance areas. To the extent that black sea bass from New Bedford/Fairhaven Harbor fail to recruit to other areas of Buzzards Bay, this decline may be reflected in the commercial or recreational harvest of the region.

Tautog (*Tautoga onitis*)

Tautog is identified as a non-resident species and is recreationally important. This fish was found to inhabit New Bedford waters from May to October, with peak densities occurring in May and in October. This behavior most likely corresponds to periods of movement in and out of the harbor, since this species is known to migrate to shallow inshore waters from deeper waters in the spring. The tautog diet consists of crustaceans, mollusks, lobsters, worms and mussels (Howes and Goehringer, 1996). Tautog may avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, as bottom feeders, this species may be indirectly impacted by the loss of their benthic invertebrate prey during UDM management activities. In response to the loss or decline of their invertebrate prey, tautog densities may decline in the vicinity of the disturbance areas. To the extent that tautog from New Bedford/Fairhaven Harbor fail to recruit to other areas of Buzzards Bay, the regional recreational and commercial harvest of this species may also be impacted.

Butterfish (*Peprilus triacanthus*)

Butterfish are common to the mid-Atlantic region, and Buzzards Bay provides an important nursery area for the species. The juvenile butterfish grow quickly and migrate to deeper waters usually in late fall only to return to the shallow inshore areas in April. The diet of the non-resident butterfish consist of copepods, small fish, jellyfish and various marine polychaete worms (Cross, et al., 1999). Commercially, butterfish are harvested and they are another important prey source for many upper level predators such as bluefish and striped bass. Historically, the butterfish has been documented as an important species for Buzzards Bay (Howes and Goehringer, 1996). Due to the migratory nature and the schooling behavior of these fish, variable year-to-year statistics are available (Howes and Goehringer, 1996). Butterfish may avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, as bottom feeders, this species may be indirectly impacted by the loss of their benthic invertebrate prey during UDM management activities. In response to the loss or decline of their invertebrate prey, butterfish densities may decline in the vicinity of the disturbance areas. To the extent that butterfish from New Bedford/Fairhaven Harbor fail to recruit to other areas of Buzzards Bay, the regional recreational and commercial harvest of this species may also be impacted.

Bluefish (*Pomatomus saltatrix*)

Bluefish are migratory non-residents of Buzzards Bay and are very important both commercially and recreationally to the embayment. Bluefish spawn offshore and enter Buzzards Bay waters as juveniles. Bluefish appear in New Bedford Harbor waters from July through September with peak densities typically occurring in August (NAI, 1999). Bluefish feed voraciously, sight feeding on almost anything in the water column, especially such favorite prey such as silversides, clupeids, striped bass, and bay anchovy (Fahay, 1999). Historically, this fish has been a documented staple for the Buzzards Bay region for over 100 years (Howes and Goehringer, 1996). Since they are dependent on sight feeding and are highly mobile, bluefish will likely avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping, resulting in lowered local abundance of this species.

Table 5-12: Fish Landings (lbs) for New Bedford/Fairhaven Harbor and Massachusetts Statewide from May-December, 1999 (x1000)

Fish Species	Pounds Landed in New Bedford	Pounds Landed in Massachusetts (Statewide - All Ports Combined)	% of State Total Landed in New Bedford
Cod	3,634	11,721	31
Haddock	869	3,533	24.6
Yellow-tailed Flounder	3,468	4,915	70.6
White Hake	83	1,539	5.4
American Plaice	705	2,402	29.3
Winter Flounder	5,157	6,426	80.2
Witch Flounder	486	1,590	30.6
Window Pane	59	65	90.8
Silver Hake	106	3,996	2.6
Monk Fish	10,642	15,990	66.5
Scallop	11,440	11,547	99.1

Source: NMFS (1999)

5.3.4 Coastal Wetlands, Submerged Aquatic Vegetation and Intertidal Flats

The following subsections discuss coastal wetlands, submerged aquatic vegetation and intertidal flats, their presence within and near the preferred disposal sites, their ecological importance, and their regulatory status under the Massachusetts Wetlands Protection and Federal Clean Water Act.

5.3.4.1 Coastal Wetlands

The Massachusetts Wetland Protection Act, 310 CMR 10.21 through 10.37, regulates coastal wetlands including numerous submerged and intertidal resource areas. Salt marshes are areas with the most stringent protection under the Act (See Section 7.1.3). In addition, the following resources are regulated under the Act: Land Under Ocean; Coastal Beaches; Coastal Dunes; Barrier Beaches; Coastal Banks; Rocky Intertidal Shores; Salt Marshes; Land Under Salt Ponds; Land Containing Shellfish; Banks of or Land Under the Ocean, Ponds, Streams, Rivers, Lakes or Creeks that Underlie Anadromous/Catadromous Fish Runs; and, Estimated Habitats of Rare Wildlife (for coastal wetlands).

The Wetland Protection Act regulations define a salt marsh as “a coastal wetland that extends up to the high tide line, that is, the highest spring tide of the year, and is characterized by plants that are well adapted to or prefer living in, saline soils. Typically dominant plants within salt marshes are salt meadow cord grass (*Spartina patens*) and/or salt marsh cord grass (*Spartina alterniflora*)”.

Salt marshes are also protected under federal law because they are wetlands; one of the “special aquatic sites” designated in the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230, Subpart E). The regulations describe possible impacts on these sites from dredged disposal, and the applicant for a dredging permit must demonstrate compliance with guidelines for avoiding adverse impacts to these areas before a permit can be issued. (See Section 7.2.5.3).

Salt marshes are located on the eastern shoreline of the Inner Harbor, just north of Popes Island. The Popes Island North site is approximately 570 feet from this marsh (Figure 5-19). The closest salt marsh to the Channel Inner is located over 5,000 feet to the north. This marsh is over one mile away from the East of Channel site.

Typical tidal areas of New England are generally formed in low energy areas such as behind protective barriers and circulation-restricted coves and bays. Typical New England salt water marshes are divided into two distinctive zones: Low marsh, which is dominated by the salt marsh cordgrass, *Spartina alterniflora*; and the High marsh, dominated by the salt marsh hay, *Spartina patens*, and the spike grass, *Distichlis spicata* (Howes and Goehringer, 1996). These zones are mostly delineated by the flooding frequency and duration of the flooding. Accordingly, low marsh environment is located between mean low water and mean high water, while the high marsh region is from high mean water to seasonal high waters elevations both vernal and autumn.

5.3.4.2 Submerged Aquatic Vegetation

Vegetated shallows (a.k.a. submerged aquatic vegetation) are regulated by DEP as “Land Under Ocean”, and are also Special Aquatic Sites protected by the federal 404(b)(1) guidelines, where they are defined as “permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation”. In marine settings of Buzzards Bay, eelgrass (*Zostera marina*) is the most common form of SAV, typically forming extensive beds. Eelgrass beds increase species diversity and productivity by providing substrate shelter and food for a variety of marine fish and invertebrates (Levington, 1982). They also stabilize marine sediments (reduce erosion and resuspension within the water column) by reducing wave energy. The formation of eelgrass beds are also the first step in saltmarsh succession (Gosner, 1978).

Eelgrass beds in New Bedford/Fairhaven Harbor were mapped by the DEP in 1997 from aerial photographs (Costello, 1997) (Figure 5-19). Extensive submerged aquatic vegetation (eelgrass beds) of New Bedford/Fairhaven Harbor occur primarily along the eastern shoreline of the Outer Harbor and west of and proximal to Little Egg Island in the middle of the Outer Harbor off of Fort Phoenix Beach. There is no mapped SAV within the Inner Harbor in the vicinity of either the Channel Inner or Popes Island North site.

5.3.4.3 Intertidal Habitats

The only areas other than wetlands and vegetated shallows, which are specifically protected under the 404(b)(1) guidelines and found in the New Bedford/Fairhaven coastal area, are mud flats. These are defined as follows in the federal guidelines:

> *"Mud flats are broad flat areas along the sea coast and along coastal rivers to the head of tidal influence and in inland lakes, ponds, and riverine systems. Wind and wave action may resuspend bottom sediments. Coastal mud flats are exposed at extremely low tides and inundated at high tides with the water table at or near the surface of the substrate. The substrate of mud flats contains organic material and particles smaller in size than sand. They are either unvegetated or vegetated only by algal mats."*

This definition differs from the state's definition of tidal flats principally in that mud flats are composed only of fine-grained material, whereas tidal flats may also include intertidal sand bars. Mud flats contain biota such as clams and marine polychaete worms, and may provide foraging and nursery areas for fish and foraging habitat for shorebirds.

Tidal flats (either mud flats or sand bars) generally occur along the various embayments along the Fairhaven (east) side of the Acushnet River south to and including the Upper and Inner Harbors. Specifically, within the Inner Harbor segment, either mud flats or sand bars occur along the south side of the marshes located just south of I-195, along the Fairhaven shore east of Popes Island, along the north side of Crow Island, within the southwest corner of the Inner Harbor segment west of Palmer's Island, east of Palmer's Island adjacent to the main navigation Channel, and on the southeast corner of Inner Harbor just north of the Hurricane Barrier.

Within the Outer Harbor, either mud flats or sand bars occur within the various embayment areas and other localized areas around the Outer Harbor perimeter. Most notably along a majority of the western shore, with in Priests Cove and adjacent portions of the northern shoreline to the east, and along the western shoreline most extensively from Silver Shell Beach, south to Wilbur Point. Available mapping for New Bedford/Fairhaven Harbor depicts the nearest tidal flats to the Channel Inner site lie within 1,700 feet to the south. Tidal flats are located 285 feet east of the Popes Island North site (Figure 5-19).

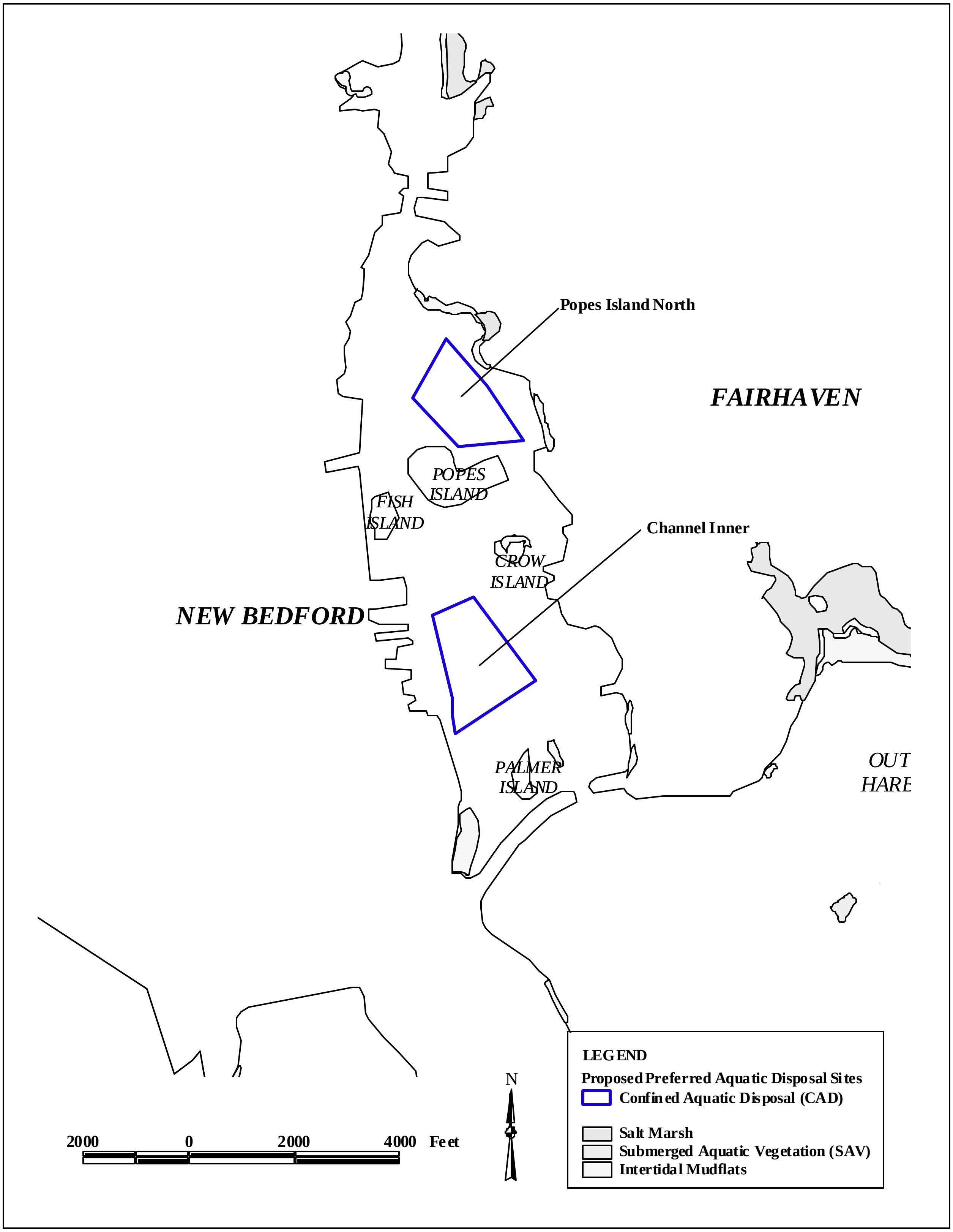


Figure 5-19: Submerged Aquatic Vegetation, Salt Marsh and Intertidal Mud Flats

5.3.5 Wildlife

The coastal waters and various coastal habitats within and proximal to New Bedford and Fairhaven including the Outer Harbor area are inhabited by various waterfowl, seabirds and shorebirds. The various species found within these habitats exhibit seasonal variations in occurrence, abundance, and habitat usage. The areas within the harbor and immediately offshore are not known to support any significant concentrations of marine mammals or reptiles. All wildlife in the area is mobile and should avoid any areas of disturbance.

5.3.5.1 Avian Habitats

In the New Bedford and Fairhaven areas, beaches and tidal flats provide potential shorebird and seabird breeding or foraging habitat. The eelgrass and intertidal flat areas with the Harbor (Figure 5-19) provide habitat for diving ducks, shorebirds, and seabirds. A general discussion of the waterfowl, shorebird, and seabird habitats of the Harbor is presented below.

Waterfowl

Diving ducks (Family Anatidae, Subfamily Anatinae, Tribes Aythyini and Mergini) can be found in Massachusetts embayments, including New Bedford/Fairhaven Harbor at any time of year, however most species are typically absent from May to September (Forster, 1994). Species richness and total abundance is greatest by late November when many farther north breeding sea ducks have arrived in the waters of eastern Massachusetts as winter residents. The total abundance may fluctuate throughout late fall to mid-winter months with the arrival and departure of somewhat transient loose flocks and individuals. Species richness and total abundance usually increases once again in late winter to early spring as the wintering waterfowl begin to stage for their flights to northern breeding grounds (Leahy, 1994).

The abundance of wintering waterfowl during diurnal cycles is usually greatest in nearshore (littoral) waters during mid to high-tide. The various species of waterfowl found within New Bedford/Fairhaven Harbor during the winter months include representatives of the herbivore (e.g. Brant, *Branta bernicla*), piscivore (e.g. Red-breasted Merganser, *Mergus serrator*), and molluscivore (e.g. Common Eider, *Somateria mollissima*) feeding guilds. During low tide, many of the deepwater (diving) species such as the seaducks and mergansers (Tribe Mergini) move out to deeper, off-shore waters (Leahy, 1994). Surface feeding ducks (Tribe Anatini) are found within New Bedford/Fairhaven Harbor, foraging in littoral waters for aquatic vegetation and invertebrates (e.g. Black Duck, *Anas rubripes;* American Widgeon, *Anas americana*, etc.).

Other waterfowl to be expected within New Bedford/Fairhaven Harbor other than ducks include the loons (Family Gaviidae), grebes (Family Podicipedidae) and cormorants (Family Phalacrocoracidae). In the Buzzards Bay region, including New Bedford/Fairhaven Harbor, loons and grebes are mainly absent as summer residents, but tend to be rare to locally common winter residents (Viet and Petersen, 1993). The species of loons (e.g. Common -*Gavia immer* and Red-throated -*G. stellata*) and grebes (e.g.: Horned, *Podiceps auritus* and Red-necked, *Podiceps grisegena*) reported by Forster (1994) to winter in coastal eastern Massachusetts embayments (including New Bedford/Fairhaven Harbor) feed mainly on fish by diving in open waters (Terres, 1980).

Of the cormorants, Double-crested Cormorants (*Phalacrocorax auritus*) are most abundant during the summer months, while Great Cormorants (*Phalacrocorax carbo*) appear in the harbor in winter months. Nearshore (littoral) and off-shore waters are used for feeding. Both species of cormorant feed primarily on fish (such as sculpins, haddock, cod, flounders, and herrings) but crustaceans such as spider crabs and shrimp may also be consumed (Terres, 1980). Food is caught by diving in open water areas. However, the harbor's reefs and rocky promontories are used by these species for roosting and sunning.

Since the Proposed Preferred Aquatic Disposal sites have been sited in areas outside of extensive eelgrass, shellfish and finfish concentration areas, these disposal sites would not have a significant impact to waterfowl populations within the harbor.

Shorebirds

Shorebirds are also expected to frequent New Bedford/Fairhaven Harbor. Numerous species of shorebirds such as the plovers (Family Charadriidae), and sandpipers (Family Scolopacidae) can be expected to frequent the intertidal flats of New Bedford/Fairhaven Harbor throughout the seasons. Typically, species richness and abundance of shorebirds is generally greatest on exposed mudflats and sandy beaches at low tide during autumn migration (late summer to early fall) with peak occurrences for various species varying throughout this time period (Forster, 1994). Although many species of shorebirds frequent mudflat habitat for feeding, some prefer pebbly or cobbly beaches (e.g. Ruddy Turnstone, *Arenaria interpres*) and others prefer rocky coast (i.e. Purple Sandpiper, *Calidris maritima*).

Shorebirds feed mainly on marine polychaetes, amphipods, and even mollusks (Terres, 1980) on tidal flats, intertidal rocks, and shallow subtidal bottoms (Levinton, 1982). These food sources tend to be more easily accessible to the birds during low tides, therefore diurnal cycles of abundance and species richness will be greatest during low tides. Sandpipers and plovers feed on surface-dwelling invertebrates such as amphipods and marine worms by gleaning from the surface or turning over stones. Larger shorebirds, such as dowitchers, whimbrels and willets, probe the soft substrata using their long bills (Levinton, 1982).

Since the Proposed Preferred Aquatic Disposal sites have been sited in areas outside of rocky coast areas, extensive mudflats and sandy beach areas as well as salt marsh, the disposal sites would not have a significant impact to shorebird populations within the harbor.

Colonial Nesting Waterbirds

Coastal seabirds such as the gull and terns (Family Laridae), pelagic seabirds such as the shearwater and petrels (Family Procellariidae), and wading birds such as herons and their allies (Family Ardeidae) nest colonially within Buzzards Bay. However no sites identified as "Principal Waterbird Colonies on the Massachusetts Coast" were identified by Veit and Petersen (1993) within New Bedford/Fairhaven Harbor. Therefore the Proposed Preferred Aquatic Disposal sites would not have an impact to these known principal nesting seabird colonies of Massachusetts.

5.3.5.2 Marine Mammals

Marine mammals found in the waters in and around Stellwagen, Nantucket and Georges Banks located east of New Bedford/Fairhaven Harbor, include thirteen species of cetaceans (whales and porpoises), and two species of seals (NOAA, 1993)(Table 5-13). Although five of the whale species are endangered, some, especially the large and conspicuous humpback (*Megaptera novaeangliae*) and fin whales (*Balaenoptera physalus*), have become locally common enough in those offshore waters to support a whale-watching industry operating from among the various Massachusetts ports located proximal to these offshore banks (i.e Salem, Gloucester, Newburyport, Plymouth, Provincetown, Nantucket, etc.). In fact, as of the end of 1998, the industry produced revenues of $20,000,000 per year and brought 860,000 people annually to Stellwagen Bank to view whales (Boston *Globe*, January 11, 1999). Most of the marine mammal species may be expected to be found occasionally in the ocean waters closer to Gloucester, Provincetown, or Nantucket but rarely, if ever, within the harbors. An exception to this is the

harbor seal *(Phoca vitulina*), which from late September to late May is commonly seen resting on sheltered and undisturbed rocky ledges in harbors, bays and estuaries from Maine to southern New England (Weiss, 1995).

5.3.5.3 Reptiles

The only marine reptiles found in the project region are sea turtles and the Northern Diamond Back Terrapin (*Malaclemys t. terrapin*). Although five species of sea turtles have been recorded in southern New England waters, only two, the leatherback (*Dermochelys coriacea*) and the Atlantic ridley (*Lepidochelys kempi*), are seen with any regularity (Payne 1991). The leatherback, the largest living reptile, may grow to 11 feet in length and weigh up to 1900 pounds. Leatherbacks breed in Central and South America and are most frequently sighted off Massachusetts from June through September. The Atlantic or Kemp's ridley is the most commonly reported turtle from Buzzard's Bay (Payne, 1991), but most of the sightings are of stranded juveniles. Individuals of this warm-water species breed in Mexico, and regularly drift or swim north as juveniles. Some become trapped in Cape Cod Bay as temperatures fall, where they are killed by the cold. They are not an important part of the fauna of Buzzard's Bay.

Among the remaining three species of turtles reported for the area, loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and the Atlantic hawksbill (*Eretmochelys imbricata*) are rarely found within southern New England waters. On the rare occasion when the Atlantic hawksbill is found in southern New England waters, it is usually found far offshore. Sightings of these three species within Buzzard's Bay are usually wandering juveniles that do not survive the winter (Weiss, 1995). Since Buzzard's Bay lies outside the normal range of most sea turtles, none of the Proposed Preferred Aquatic Disposal sites will have a negative impact on the status of marine reptile populations in the region.

Terrapins inhabit tidal creeks, bays and marshes from Cape Cod, south along the Atlantic coast to the Florida Keys, then westward along the Gulf Coast including most of the Texas coastline (Klemens, 1993). Its distribution in southern New England outside of Connecticut is very localized, with populations in Massachusetts reportedly occurring in Wellfleet on Cape Cod. Given the extent of development and disturbance in the New Bedford/Fairhaven Harbor, the project areas are unlikely to support populations of this species.

Table 5-13: Marine mammals found in the waters over and around Offshore Fishing Banks in Massachusetts (NOAA, 1993)

Common Name	Scientific Name	Remarks
Humpback whale	*Megaptera novaeangliae*	March-November, offshore, near bank
Northern right whale	*Eubalaena glacialis*	Late winter - July
Fin whale	*Balaenoptera physalus*	Peak April - October, offshore
Sei whale	*Balaenoptera borealis*	Very rare
Blue whale	*Balaenoptera musculus*	Very rare
Minke whale	*Balaenoptera acutorostrata*	Peak spring - late summer/early fall
Pilot whale	*Globicephala* spp.	(2 species)
Killer whale	*Orcinus orca*	Peak mid-July through September
White-sided dolphin	*Lagenorhynchus acutus*	Common all year
White-beaked dolphin	*Lagenorhynchus albirostris*	Rare, April - November
Harbor porpoise	*Phocaena phocaena*	Peak in spring
Bottlenose dolphin	*Tursiops truncatus*	Late summer/fall, offshore
Common dolphin	*Delphinus delphis*	Occasional, fall/winter, offshore
Harbor seal	*Phoca vitulina*	Common, nearshore
Gray seal	*Halichoerus grypus*	Abundant in Canada, rare in Massachusetts

5.3.5.4 Endangered Species

The Massachusetts Natural Heritage Atlas does not indicate any estimated habitat of state-listed Endangered, Threatened or Special Concern species in or adjacent to the marine waters of the New Bedford/Fairhaven area. It does not indicate any priority sites of rare species habitats or exemplary natural communities in this area.

Of the marine mammals and reptiles reported on in Sections 5.3.5.2 and 5.3.5.3, five whales and two turtles are federally listed as endangered. These include the humpback whale, fin whale, sei whale, blue whale, northern right whale, leatherback turtle and the Atlantic or Kemp's ridley turtle. These species, if they attain enough numbers to have centers of concentration at all, are found mainly at offshore upwelling sites like Stellwagen, Nantucket and Georges Banks outside of Buzzards Bay and offshore from Massachusetts Ports.

5.3.6 Historical and Archaeological Resources

5.3.6.1 General

The Port of New Bedford is rich in maritime history. Native Americans used the harbor extensively for fishing (Reiss, 1998), with the marine resources sustaining thousands of people (Howe and Goerhinger, 1996). The first European settlers to the region were Quakers and Baptists who purchased the New Bedford Harbor area from the Native Americans in 1654. It was soon settled by more colonists who established shipbuilding as an important local industry by the mid-1700s. During the American Revolution, New Bedford was raided by the British and many buildings and other structures were burned. By the mid-1800's, New Bedford had developed into the largest American whaling port. Other industries emerged including textiles, and metal products.

It's importance as a commercial fishing port has not diminished. It is currently the largest commercial fishing port in New England. It's maritime history is preserved in many museums and exhibits in the region. Because of New Bedford's long maritime historical significance, a reconnaissance survey of the potential shipwrecks and aboriginal (Native American) sites in the Harbor was conducted.

As requested by the Massachusetts Board of Underwater Archaeological Resources, a reconnaissance survey was conducted to identify the potential for historical (shipwrecks) and archaeological (aboriginal) sites for the New Bedford/Fairhaven DMMP. Excerpts from the survey appear in Sections 5.3.6.2 and 5.3.6.3, below, with the full survey report in Appendix H.

5.3.6.2 Historical Shipwrecks

To determine significance for each shipwreck the Department of the Interior's definition of eligibility for the National Register of Historic Places (i.e. generally sites over fifty years old) was used as guidance. However, most of the shipwrecks were over one hundred years old. Because the recording of shipwrecks was not done in a thorough and programmed manner in the 19th and early 20th century, the information for any particular site might be inaccurate. However, the approximate number of significant shipwreck sites in the New Bedford/Fairhaven study area is accurate enough to allow the determination that pre-dredging/disposal planning is recommended.

The survey-level historical research located a total of 22 shipwrecks located in the New Bedford/Fairhaven area and an additional fifty-nine in Buzzards Bay. Of the total number of known shipwrecks, the exact location of only two shipwreck sites could be determined within the harbor. The names of these two known shipwreck sites were not determined during the field reconnaissance. The location of the remaining sites in relation to the Proposed Preferred Aquatic Disposal sites cannot be determined. Despite this factor, sixty-three sites would fit the Department of the Interior's eligibility for the National Register of Historic Places (Reiss, 1998).

Two sunken vessels are depicted within the New Bedford/Fairhaven Harbor on the NOAA navigation charts of the harbor. One is located north of Fort Phoenix between the hurricane barrier and the first wharf depicted on the eastern (Fairhaven) shoreline upstream of the barrier. Another is depicted along the western (New Bedford) shoreline north of Fish Island.

In addition to those vessels found in the historical records, we must assume many others were lost in the study area and not recorded. Before radios and radar, vessels were surely lost with all hands on the numerous ledges in the area during storms and fogs. Others could only record them as missing at sea, whether they had just left the harbor, were returning after a long voyage, or were blown in while trying to sail past the shore. No one would know what happened to them. They would include small and large fishing boats, coasters, and transoceanic merchant men and warships.

Besides those vessels lost while underway, a number would have been lost at their moorings or abandoned in shallow water, such as the abandoned 1800s fishing vessel seen at low tide on the western shore of Manchester Harbor and the 1690s Hart's Cove shallop in Newcastle, New Hampshire. Some of the shipwrecks would have been salvaged shortly after wrecking or more recently.

Since we know so little of the early vessels, onboard fishing processes, or life aboard the early merchant vessels, the remains of any historic ship or boat would be archaeologically and historically significant on a local, regional, and national level.

Historic shipwreck sites are known to exist in the study area and are relatively easy to detect. The number of vessel losses found in this study is smaller than the total losses that would be located with a complete study, but the results found are indicative of a large number of probable shipwreck sites within or proximal to the Harbor. The lack of complete recorded evidence is typical for any locality along the New England shore. Until recently the loss of a vessel, even with the loss of life, was not considered newsworthy enough for the ubiquitous 4-page weekly newspaper in the 1700s and 1800s. State and federal government compilations of vessel losses, which are incomplete, date only from the very late 1800s. In addition, the parameters of this study only included some primary research with mostly the inspection of secondary compilations of data from the primary sources. The data located in this study indicate that there is a probability of encountering the remains of an historic vessel in or near the Proposed Preferred Aquatic Disposal sites. However, because this area was dredged for the creation of the Federal Channel, the remains of a shipwreck may have already been removed, wholly or in part.

Field surveys of the sites and vicinity will be conducted to ascertain if any shipwrecks or shipwreck debris is present. See Appendix H for a detailed scope of work.

5.3.6.3 Archaeological Sites

Prehistoric Indians (Native Americans) used the harbor for fishing and the shoreline for residences. The harbor was the access to the bountiful food offered by the sea. Indians were known to collect many types of shellfish which were smoked, dried, stored and traded for winter food. They used small dugout and bark canoes for fishing and hunting mammals, and for transportation along the shore and to nearby islands (Reiss, 1998).

In most areas of New England, seasonal Indian dwelling sites are typically found near a beach and a fresh water source with a southeast exposure to the sea. In addition, shell middens, created by Indians processing bivalves, are often found in similar areas without the need of running fresh water (Bourque, 1980, IV-45-49 & Reiss, 1989, 12). Since the last ice age, the net sea level change has placed the coastline of 6,000 BP under approximately 25 feet (7.62 meters) of water in the Cape Ann area (Bourque, 1980, IV-229).

Since little is known of the prehistoric Indians of the study area, any remains, whether a village, fish processing site, or sunken canoe, would be of great importance. However, previous sub-bottom profiling data indicate that the area has an irregular bedrock surface which is typically covered by 0-30 feet (0 to 9.1 meters) of glacially deposited medium sand and some organic and clay sediment.

Remains of any sites would be extremely hard to locate under the sediment in the survey area. Remote sensing surveys will generally not indicate a prehistoric site in this type of topography. Locating prehistoric Indian sites would require archaeological trenching of each proposed impact area. Spot inspection by archaeological divers, while investigating remote sensing targets of possible historic remains, would be useful, but probably not productive.

5.3.7 Navigation and Shipping

The federal navigation projects in New Bedford/Fairhaven Harbor consists of a main channel extending from deep water in Buzzards Bay through the New Bedford-Fairhaven Bridge (U.S. Route 6); a channel extending from the lower maneuvering area along the upper waterfront to the vicinity of Fish Island and the swing bridge; a channel west of a line channel ward of the Fairhaven Harbor lines from Pierce and Kilburn Wharf to the old causeway pier; and an anchorage area north of Palmer Island, off the Fairhaven main waterfront. (USACE 1996)

The entrance to New Bedford/Fairhaven Harbor lies easterly of Clark Point and westerly of Wilbur Point in Buzzards Bay, leading to the Outer Harbor. Entrance to the Outer Harbor is via the main Federal Channel, Entrance Channel and Fort Phoenix Reaches, which begin respectively, at points 3.8 nautical miles (nm) and 1.5 nm southerly of the Hurricane Barrier. Both of these reaches are 350 feet wide with a depth to MLW of 30 feet (Figure 5-2).

Table 5-14: New Bedford Harbor Main Channel Reaches

Name of Reach	Width (feet)	Length (nautical miles)	Depth to MLW (feet)
Entrance Channel	350	2.3	30
Fort Phoenix	350	1.5	30
New Bedford	350-400	0.7	30

Source: Buzzards Bay Navigational Chart, NOAA - 1979

The entrance to the Inner Harbor, through the Hurricane Barrier, is via the New Bedford Reach of the Federal Channel with a depth to MLW of 30 feet, with a width ranging between 350 and 400 feet for a length of 0.7 nm (Figure 5-2). Easterly of the New Bedford Reach on the Fairhaven side of the harbor, is an anchorage area with a depth to MLW of 25 feet and two channels with depths of 15 feet and 10 feet. The 15 foot channel is between 150-400 feet wide, westerly of a line 50 feet channelward of Fairhaven

Harbor lines from Peirce and Kilburn Wharf to Old South Wharf, thence, 10 feet deep, 150 feet wide to a point 1,000 feet south of the old causeway pier. On the westerly and northerly portions of the New Bedford Reach, are two 30 foot maneuvering areas for the State Pier and North Terminal areas(USACE, 1986).

Restrictions to navigation in New Bedford/Fairhaven Harbor include two swing bridges and the Hurricane Barrier. The Coggeshall Street Bridge, just north of the Route I-195 bridge has a vertical restriction of 4 feet at MHW. The Route 6 bridge, connecting New Bedford and Fairhaven across Popes Island, has a vertical restriction of 6.3 feet at MHW. A horizontal restriction of 150 feet exists in the Hurricane Barrier.

Although vessel movement data are not available for fishing or recreational vessel traffic both type of vessels contribute to harbor traffic. To gain a sense of the potential amount of activity associated with these types of vessels, New Bedford/Fairhaven Harbor is home to a recreational boating fleet of over 950 vessels and a commercial fishing fleet of approximately 265 vessels. (New Bedford/Fairhaven Harbor Plan, 1999).

In addition to the vessel movements associated with fisheries industry activity in New Bedford/Fairhaven Harbor, other maritime commerce activities generate vessel trips that need to be accounted for when considering aquatic disposal options. In 1998, a total of 2,505 inbound trips and 2,514 outbound trips within New Bedford/Fairhaven Harbor, or a total of 5,019 vessel movements, were reported. Approximately 70% of both the inbound and outbound traffic was attributable to tanker traffic, with the remainder of trips being generated by passenger and dry cargo vessels and tow or tug boats (USACE, 1998). Table 5-15 shows inbound and outbound vessel traffic for self propelled and non-self propelled vessels.

Table 5-15: New Bedford/Fairhaven Harbor Vessel Trips, 1998

	Self Propelled Vessels			**Non-Self Propelled Vessels**		**Total**
Vessel Type	**Passenger & Dry Cargo**	**Tanker**	**Tow or Tug**	**Dry Cargo**	**Tanker**	
Inbound	756	4	882	173	690	2,505
Outbound	757	4	881	173	699	2,514
Totals	1,513	8	1,763	346	1,389	5,019

Source: USACE, Waterborne Commerce of the United States, 1998

5.3.8 Land Use

Land use at the closest landward point to the Proposed Preferred Aquatic Disposal sites, is a mixture of undeveloped, residential, commercial and industrial usage (Figure 5-2). Land usage at the closest landward point to the New Bedford Channel Inner site is The New Bedford Gas and Edison Light Company Wharf with adjacent commercial or industrial uses along South, Cape and Hassey Streets in New Bedford. Land usage at the closest landward point to the Popes Island site is Popes Island itself, which is developed with a Marine Park and radio communication towers. Land usage at the closest landward point to the West of Channel Site is a mixture of residential, institutional, commercial, and industrial usage. The nearest land use to the East of Channel Site is a public park (Fort Phoenix Beach State Reservation) and. Egg island, a tiny undeveloped island surrounded by rocky shoals.

5.3.9 Air Quality and Noise

5.3.9.1 Air Quality

Background air quality in New Bedford Harbor has been estimated using monitoring data reported by the DEP to the USEPA Aerometric Information Retrieval System (AIRS). Although the DEP does not operate any air pollution monitors within or near New Bedford.

The USEPA mandates monitoring of the following six criteria air pollutants: nitrogen dioxide (NO_2), particulate matter with diameters less than or equal to 10 microns (PM_{10}), sulfur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), and lead. Ambient Air Quality Standards (AAQS) have been established for each of these pollutants to protect the public health and welfare, with a margin of safety. PM_{10}, O_3, and NO_2 emissions are those associated with operation of heavy equipment used in UDM disposal operations. Ozone is not a pollutant emitted by heavy equipment, but is formed in the atmosphere when “precursor” elements and compounds such as nitric oxides, hydrocarbons (e.g. from unburned fossil fuels) and oxygen are combined in the presence of sunlight.

A geographic area that meets or exceeds an AAQS is called an attainment area for that air pollutant standard. An area that does not meet an air standard is called a non-attainment area for that standard. The entire state of Massachusetts is in attainment of all criteria air pollutant standards except for ozone, for which it is classified as in serious non-attainment. A summary of existing air quality data for Bristol county is as follows:

Nitrogen Dioxide (NO_2)**:** The nearest monitoring station for this pollutant is in Easton, MA. From 1998-2000 there were no violations of the annual standard of 0.053 ppm. Annual measurements ranged from 0.006 to 0.009 ppm.

Particulate Matter 10-Microns (PM_{10}): At a monitoring station in New Bedford, readings of 14.3 to 17.8 ppm (annual average) were recorded. This is well below the standard of 50 g/m3.

Sulfur Dioxide (SO_2): The nearest monitoring station for sulfur dioxide is in Fall River. From 1995-2000 there were no exceedances of the EPA standards. Annual means during this period were 0.004 to 0.005 ppm, which is well below the annual standard of 0.03 ppm.

Ozone (O_3): The nearest monitoring station for ozone is in Fairhaven. Exceedances of the 1-hour standard of 0.12 ppm occurred twice in 1995 and 1999 and one each in 1996 and 1997. Statewide, Massachusetts continues to be in non-attainment of the O_3 standard.

Carbon Monoxide (CO): The nearest monitoring station for CO is in East Providence, RI. No violations of the 1-hour or 8-hour standards were recorded from 1995 to the present.

Lead (Pb): The closest monitoring station for lead is in Boston. Since 1995 there have been no exceedances of EPA's lead standard.

Overall, the existing air quality in the New Bedford/Fairhaven area is good and is in compliance with all state and federal air quality standards except for ozone. Statewide non-attainment for the ozone standard requires that Massachusetts continue to make progress on implementing a State Implementation Plan (SIP) for attaining the standard.

5.3.9.2 Noise

New Bedford/Fairhaven Harbor is a heavily commercialized port, and as such nearshore areas in these communities exhibit noise levels typical of commercial environments. Industrial noises, such as that associated with operation of a seafood processing plant or traffic noise from shipping and commerce, all contribute to the existing noise environment. Generally speaking, the Outer Harbor is much quieter especially in the vicinity of recreational areas, such as Fort Phoenix Beach State Reservation at the far southwestern corner of the Town of Fairhaven, and in the vicinity of residential areas, such as the Harbor View, Pope Beach and Silver Shell Beach neighborhoods of Fairhaven.

5.3.10 Recreational Resources

Recreational resources in New Bedford/Fairhaven Harbor are abundant, and reflect a wide range of passive and recreational activities. Predominant among the recreational uses of the harbor are boating and sailing, swimming, and fishing.

There are several recreational marina, boat yards and yacht clubs located in New Bedford/Fairhaven Harbor. In addition, numerous single point moorings are located just south of Popes Island and along the Fairhaven shoreline in the Lower Harbor. In addition, several dockside restaurants are located within the Harbor.

Recreational fishing is a significant activity, with winter flounder, cod, mackerel, bluefish, scup and seabass and striped bass the most important recreational species. Section 5.3.3.6 provides a more complete description of recreational fishing within the Harbor.

Public parks abutting New Bedford/Fairhaven Harbor include Fort Phoenix Park, a state-owned reservation located in the southwest corner of Fairhaven at the eastern end of the hurricane barrier. This park provides public beach access and picnic areas. A marine park is located on the southern side of Popes Island. Smaller municipal parks are also located along the waterfront on the western side of the harbor, such as the one located just north of the hurricane barrier in New Bedford. These small municipal parks generally contain neighborhood playgrounds. Private beach areas most likely service the communities of Harbor View, Pope Beach and Silver Shell Beach neighborhoods of Fairhaven.

5.3.11 Economic Environment

New Bedford Harbor has shaped the identities and economies of both the City New Bedford and Town of Fairhaven for over 150 years. Today New Bedford/Fairhaven is one of the nation's preeminent fishing ports, ranked first in 1996, among east cost ports, and second nationally based upon the value of product landed. New Bedford harbor is home to one of the largest commercial fishing fleets in the Northeast Seaboard region, recording the greatest tonnage of commercial caught fish for 5 species (cod, yellowtail flounder, winter flounder, windowpane flounder, and monkfish).

The harbor's seafood processing industry has grown in size and sophistication in recent years and is a nationally and internationally established industry center. Marine service and vessel repair industries, centered in Fairhaven, have an established reputation all along the east coast and have diversified to capture markets associated with recreational vessels. With over 950 recreational boat slips, the New Bedford/Fairhaven Harbor is an important center for recreational boating and has potential for expansion. And with the recent establishment of New Bedford Whaling Historical National Park, the harbor's history and cultural heritage is gaining increased visibility and recognition nationally, resulting growing tourism visitation (Harbor Master Plan, 1999).

The dominant sectors of the New Bedford/Fairhaven Harbor economy have evolved over the centuries from a whaling port, to a harbor dominated by industrial manufacturing, to its present state as a predominant fishing port. Harbor-related businesses are estimated to account for 3,700 jobs in the local area contributing $671 million in sales to the local economy (Table 5-16). The "core" seafood industries, harvesting vessels and dealers/processors, contribute over 90% of the sales and approximately 70% of the jobs for harbor-related businesses. The New Bedford/Fairhaven Harbor Plan identifies the following key economic sectors of harbor-related businesses:

- *Fishing Industry* - Accounting for 45% of Massachusetts' employment in the harvesting sector.

- *Seafood Processing/Wholesaling* - Seafood processors in the harbor have been successful in diversifying sources of supply both nationally and internationally to overcome local shortages of product.

- *Seafood Auction* - The existing display auction has been successful in its first two years, with over 50% of New Bedford's total volume of groundfish landed being sold at the auction.

- *Waterborne Freight* - To improve this struggling sector, future strategies need to be developed to regain the economic benefits of handling ocean freight.

- *Commercial Recreation and Tourism* - Measures to increase capturing tourists need to be implemented to capitalize on the New Bedford Whaling National Park and drawing visitors to the waterfront (Harbor Master Plan, 1999)

Table 5-16: New Bedford/Fairhaven Harbor Economic Summary Data

	Approximate # of Jobs	Estimated $ Generated
Seafood Industries	2,600	$609,000,000
Other Harbor-Related Industries	1,100	$62,000,000
Totals	3,700	$671,000,000

Source: New Bedford/Fairhaven Harbor Plan, 1999

To quantify the total value in dollars of other maritime commercial activities, data for imports and exports were reviewed. Total imports for 1999, in New Bedford/Fairhaven Harbor were valued at $27,157,467, representing an increase of greater than ten fold over import values from 1998. Even with an increase in total export weight between 1998, and 1999, export values for New Bedford/Fairhaven Harbor in 1999, corresponding with a decrease of 21% over 1998, exhibited a total value of $2,310,707. The composite increase in total imports and exports is approximately 488% between 1998, and 1999, for a total value of $29,468,174 in 1999 (US Maritime Administration, 2000). Table 5-17 illustrates total weights and total values of imports and exports for 1998, and 1999.

Table 5-17: Imports and Exports for New Bedford/Fairhaven Harbor, 1998, and 1999

Year	Total Weight (Kilograms)	Total Weight (Short Tons)	Total Value (US Dollars)
Imports			
1999	113,446,440	125,074	$27,157,467
1998	50,749,426	55,951	$2,073,272
Exports			
1999	342,580	378	$2,310,707
1998	54,393	60	$2,940,354
Total Imports and Exports			
1999	113,789,020	125,452	$29,468,174
1998	50,803,819	56,011	$5,013,626

Source: US Maritime Administration, 2000

To quantify the annual volume of commodities freight traffic for New Bedford/Fairhaven Harbor, a ten year average was calculated. The annual average was determined to be 512,500 short tons (Table 5-18). The 1998 breakdown of commodities by category indicates that petroleum and crude materials represent approximately 98% of the volume of commodities freight for New Bedford/Fairhaven Harbor with chemicals, food and farm product and manufacture equipment comprising the remaining 2% of total volume. Table 5-19 indicates the freight traffic by commodities category and Figure 5-20 illustrates the percentage breakdown of Commodities Freight by percentage of total volume (USACE, 1998).

Table 5-18 : Ten Year Annual Commodities Freight Totals

Year	Commodities Freight Totals (Short Tons)
1989	456,000
1990	406,000
1991	503,000
1992	484,000
1993	503,000
1994	601,000
1995	570,000
1996	516,000
1997	554,000
1998	533,000
10 Year Average	512,500

Source: USACE, Waterborne Commerce of the United States, 1998

Table 5-19: Freight Traffic Breakdown, 1998

Commodities	Freight Traffic (Short Tons - 1,000s)
Petroleum, and Petroleum Products	304
Chemicals, and Related Products	6
Crude Materials, Inedible Except Fuels	219
Food and Farm Products	0
Manufactured Equipment, Machinery and Products	3
1998 Total	533

Note: Food and Farm Products category was less than 500 tons, 1998 total reflects rounding

Source: USACE, Waterborne Commerce of the United States, 1998

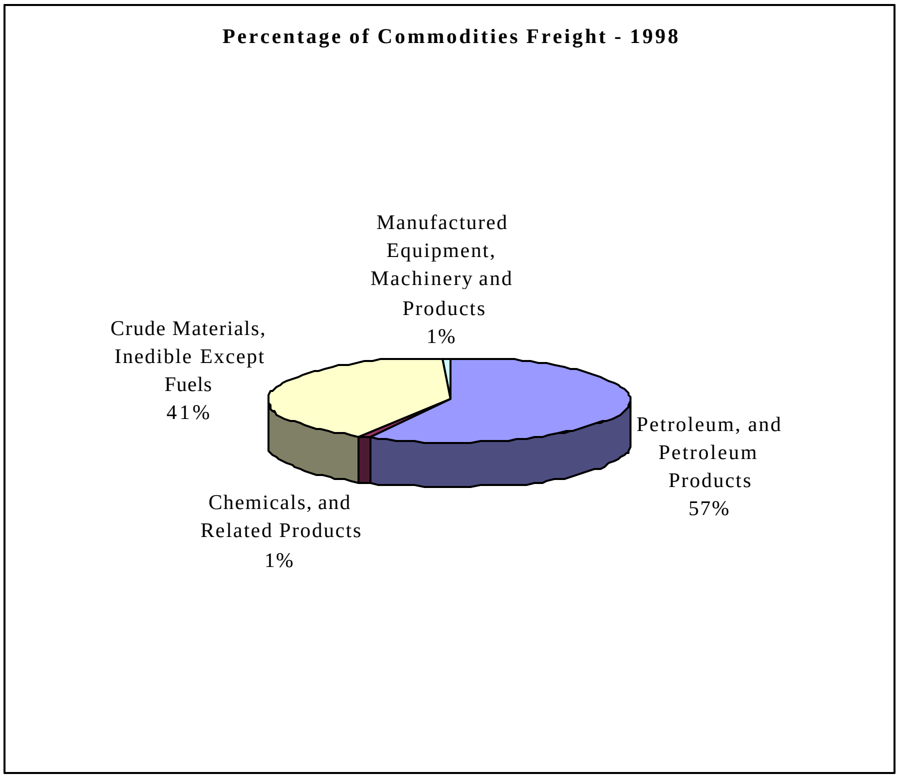


Figure 5-20: Percentage Breakdown of Freight Commodities for New Bedford/Fairhaven Harbor, 1998.

In January of 1999, DMF estimated the total values of New Bedford/Fairhaven Harbor's quahog resources. The value to fisherman calculated reflects the dollar values paid to shell fishermen. The consumer market value of the standing crop was obtained by applying an economic multiplier. The total value of New Bedford/Fairhaven Harbor's standing quahog crop to shell fishermen was calculated to be $17,004,228 (Table 5-20) with a total consumer market value of $76,519,027 (DMF, 1999).

Table 5-20: Economic Value of Quahogs for New Bedford/Fairhaven Harbor (Inner and Outer)

Harbor Segment	Value to Fisherman	Consumer Market Value
Inner Harbor	$11,503,725	$51,766,763
Outer Harbor	$5,500,503	$24,752,264
Total	$17,004,228	$76,519,027

Source: DMF, Quahog Standing Crop Survey, 1999

The City of New Bedford has been working to develop the Harbor as a destination for the cruise industry in conjunction with the City's growing tourist industry. American Cruise Lines's *American Eagle,* a brand new luxury liner, will make nine visits to the Harbor in the Summer of 2000. The addition of waterborne tourism to the harbor, will help diversify the use of the waterfront, while maintaining a viable seafood industry(New Bedford, 2000).

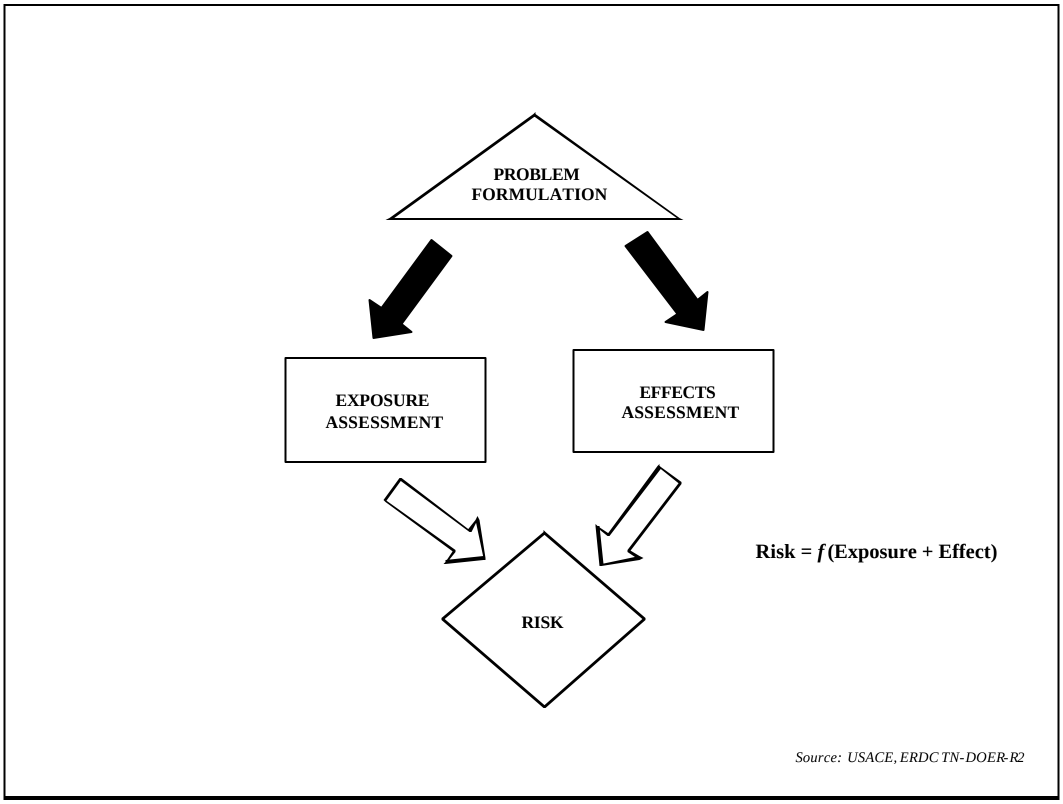


Figure 5-21: USEPA Risk Assessment Paradigm

5.3.12 Risk Assessment Synopsis

Risk assessment is basically a problem formulation to evaluate risk as a function of exposure to the environment and on human health (Figure 5-21). The evaluation and determination of potential dredging and disposal impacts on both environmental and human resources are useful planning tools when evaluating alternative disposal locations. As part of developing a remedy to address the environmental release described below, the USEPA conducted risk assessments associated with the New Bedford/Fairhaven Harbor Superfund project to evaluate associated ecological and human health impacts. A literature search was conducted as part of the DMMP to summarize past risk assessments conducted to establish a baseline for comparative purposes.

5.3.12.1 Problem Formulation

From the late 1940s until 1977, manufacturers in New Bedford discharged industrial wastes containing PCBs into New Bedford/Fairhaven Harbor and nearby coastal environments, resulting in widespread, severe contamination of the sediments, water column and biota of the Harbor estuary and parts of Buzzards Bay. Previous environmental studies conducted indicate the widespread contamination by polychlorinated biphenyl (PCBs) and other heavy metals such as copper, cadmium and lead. See studies by Hoff D.J. et al., 1973, Kolek and R. Ceurvels, 1981, McMullin, T.A., 1976, Nemerow, N.L., 1978, Sittig, M., 1975, Summerhayes, C.P et al., 1977, and Teal, J. and M. Teal, 1969. In 1979, due to the contamination of PCBs and other heavy metals, large areas of New Bedford/Fairhaven Harbor were closed to fishing. The justification for closing the fishing industry in the harbor was to reduce the potential for human exposure to PCBs.

In July 1982, under the direction of the Comprehensive Environmental Response, Compensation and Liability Act (or Superfund) (42 USC§9601 et seq.), the USEPA added New Bedford/Fairhaven Harbor to its Interim National Priorities List (NPL).

5.3.12.2 Ecological Risk Exposure Synopsis

The USEPA conducted an ecological risk assessment for New Bedford Harbor. The findings of the assessment confirmed extensive PCB contamination of water, sediments, and biota in the harbor, with sediment concentrations reported in excess of 100,000 parts per million (ppm) in the area of maximum contamination (EBASCO 1990).

An exposure assessment was performed by USEPA to identify representative organisms within New Bedford/Fairhaven Harbor that may be or have been exposed to PCBs and other metals. For the purposes of accumulating results at various (simulated) points in time, the transportation model used divides the estuary and harbor into five zones. These zones are based in part on natural and manmade structures and on the initial contaminant concentrations detected in the sediment.

The models used by the USEPA to evaluate risk to aquatic biota included a joint probability analysis. One distribution analysis represents contaminant levels in various zones of the harbor, while the other distribution represents the sensitivity of biota to contaminants (EBASCO, 1990). The two probability distributions were combined to present a comprehensive probabilistic evaluation of risk. These models were supplemented by: 1) comparisons of PCB levels in the harbor to USEPA water quality criteria (AWQC), 2) an evaluation of site-specific toxicity tests; and, 3) the examination of data on the structure of faunal communities in the harbor (EBASCO, 1990).

In conclusion, the analysis conducted by the USEPA to assess ecological risk and exposure associated with PCB contamination in the harbor indicated that levels in Zones 1, 2 and 3 have the potential to strongly impact individual biota in the harbor, as well as the overall integrity of the harbor as an integrated functioning unit (EBASCO, 1990). This impact may take the form of numerical changes at the population level, changes in community composition and ultimately ecosystem stability. For Zone 4, ecosystem level disruptions are less strongly indicated but are still likely. The results of numerous site-specific and laboratory studies indicate that New Bedford/Fairhaven Harbor is an ecosystem under stress and there is a high probability that PCBs are a significant contributing factor to the integrity of the harbor as an integrated functioning ecosystem (USEPA, 1998).

Proposed Preferred Alternatives

The proposed preferred alternatives within Zone 3 (Popes Island North) and Zone 4 (Channel Inner) are located in areas identified as posing ecological risks as a result of contamination by Superfund material located within the harbor. Popes Island North CAD site is located in an area identified with the potential to strongly impact the overall integrity of the harbor. The Channel Inner site is located in an area that was identified as an area likely posing ecological risks (Figure 5-22).

5.3.12.3 Human Health Exposure Synopsis

In addition to the ecological risk assessment conducted by the USEPA, a baseline public health risk assessment to estimate the probability and magnitude of potential carcinogenic and non-carcinogenic adverse health effects related to the release of Superfund contaminants as described above into New Bedford/Fairhaven Harbor. The USEPA's evaluation considered PCBs and other metals that could potentially contribute to adverse health effects. A baseline assumption of the evaluation was that contaminant concentrations would not change significantly over a ten-year period. Quantitative and qualitative estimates of the likelihood of adverse human health effects through several pathways were made. The following pathways were considered to assess the potential exposure to hazardous substances; ingestion of contaminated seafood, direct contact with contaminated shoreline sediment and incidental ingestion of contaminated shoreline sediment by children. Two other pathways deemed not to result in significant adverse health effects, included exposure while swimming and inhalation of airborne PCBs near the harbor (USEPA, 1998).

Conservative factors, where the true risk is unlikely to be greater than the risk predicted, were applied by USEPA to evaluate cancer risk. A health hazard index was also developed to evaluate the pathways for non- carcinogenic adverse health effects. Estimated risks from seafood consumption, skin contact and ingestion of sediment were evaluated. The greatest risk pathway identified was through the consumption of local seafood. For more detailed information the reader is encouraged to review the more detailed account of the baseline health risk assessment in "EBASCO 1989" (USEPA, 1998).

Proposed Preferred Alternatives

The areas of the Channel Inner and Popes Island North CAD sites under consideration in the DMMP are located in the portion of the harbor corresponding with Area 1 (from the Wood Street bridge southerly to the Hurricane Barrier) of the USEPA risk assessment. This area also corresponds with the area of New Bedford/Fairhaven Harbor that is closed to all fishing and swimming activities.

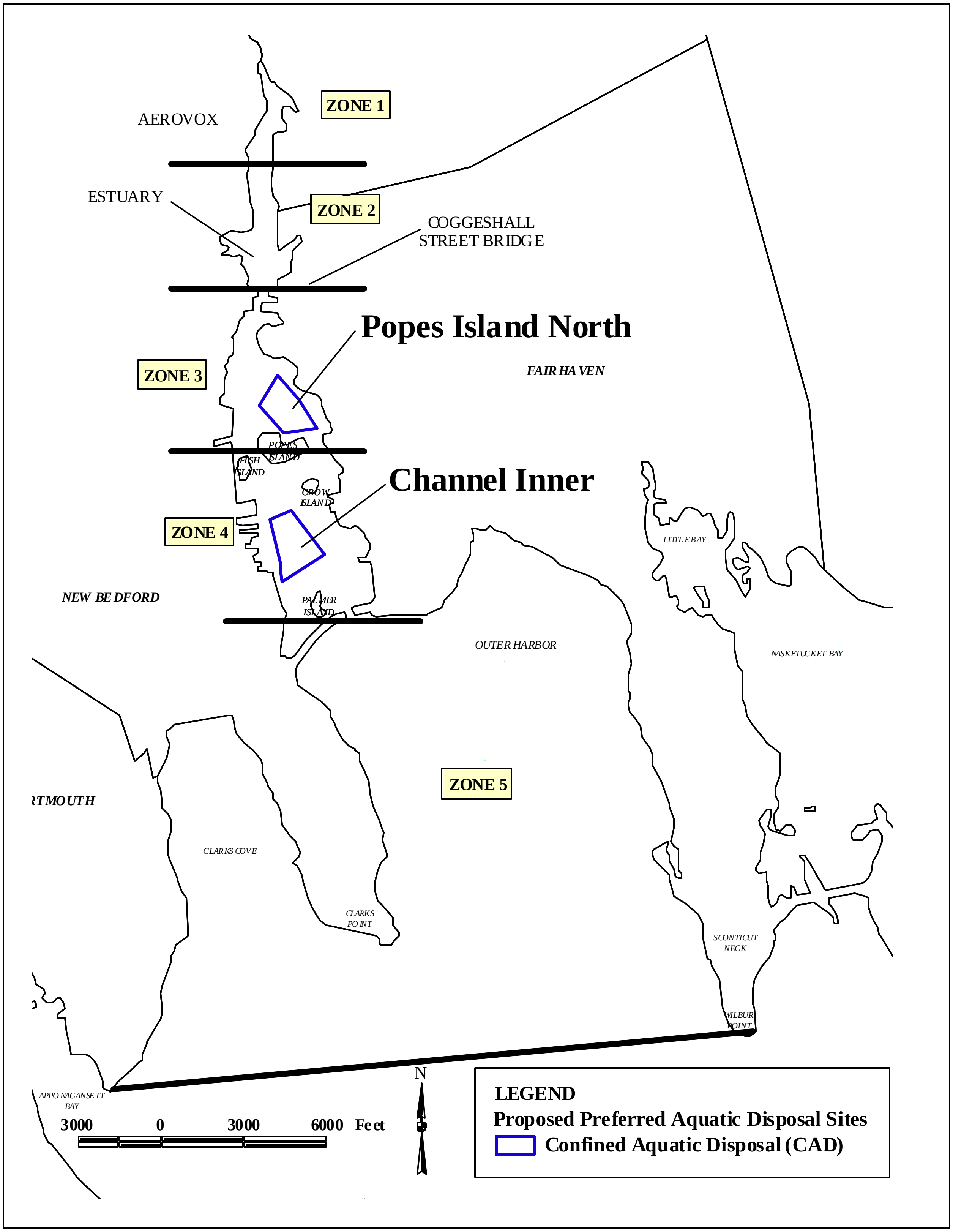


Figure 5-22: Exposure Zones Evaluated by the USEPA for Ecological Risk (EBASCO, 1990)

5.3.13 Environmental Justice

The draft Environmental Justice Policy of the EOEA asserts, defines environmental justice as "... all people have the right to be protected from environmental pollution and to a clean and healthful environment." It is EOEA's policy of the Executive Office of Environmental Affairs that environmental justice include the equal protection and meaningful involvement of all people with respect to the development, implementation and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits. This policy is implemented through regulatory and resource agencies of the Commonwealth.

The need for environmental justice has been most widely recognized in communities of color and in low-income communities. The EOEA utilizes specific indicators based on social/economic, sensitivity/vulnerability and environmental data. Under the draft guidelines of the EOEA, a region that has fifteen (15) percent or more of the population as non-white and low income (U.S. Census Bureau) qualifies the municipality as an Environmental Justice Community. Other criteria presented include sensitivity/vulnerability measures such as low birth weight, incidence of cancer, and incidence of lung and bronchus. Based on U.S. Census Bureau data, the following analysis of the City of New Bedford and the Town of Fairhaven are provided below (Table 5-21).

Table 5-21: Environmental Justice Criteria Analysis for New Bedford and Fairhaven

	New Bedford	**Fairhaven**
Total Population*	99,922	16,132
Population - non white (17.8% MA avg.)*	12,164 (12.2%)	376 (2.3%)
Population - low income Household Income <$10,000^^	16,430 of 97,908 (16.8%)	1,032 households of 15,825 (6.5%)
Population - foreign-born^	20,865 of 99,922 (21%)	873 of 16,132 (5.4%)
Population - non-English speaking^	9,573 of 92,402 (10.4%)	170 of 15,180 (1%)
Incidence of low birth weight (7.1% MA avg.)^^	94 of 1,267 (7.4%)	10 of 139 (7.1%)
Incidence of all newly diagnosed cancer types for 1994 to 1998**	2,571 (obs) of 2,695 (exp)	536 (obs) of 483 (exp)
Incidence of lung and bronchus for 1994 to 1998**	372 (obs) of 393 (exp)	79 (obs) of 72 (exp)

References:

*1990 U.S. Census Data - long form (STF 3)
^ Poverty Level Based on Income in 1989
^^Massachusetts Births 1999
**Cancer Incidence in Massachusetts 1994-1998
n/a: Data not available for Fairhaven from U.S. Census Data

The boundaries of the two aquatic proposed preferred alternatives are physically located within the jurisdictional waters of the City of New Bedford and the Town of Fairhaven in New Bedford/Fairhaven Harbor. Thus, the environmental justice policy of MEPA is considered for these municipalities as potential environmental justice communities.

Based on the data presented in Table 5-21 and the EOEA guidelines, portions of both communities qualify for status as environmental justice communities. Additionally, the EPA has classified parts of both municipalities as environmental justice communities as verified by the EPA, New England Office. Specifically, several census blocks in New Bedford scored higher for environmental criteria than Fairhaven but Fairhaven had at least one census block that did score on the environmental justice criteria for EPA (M. Barry, personal communication, October 26, 2001). Table 5-20 indicates that the household income below $10,000 (poverty level) exceeded the 15% threshold of the EOEA for New Bedford but not for Fairhaven. However, the non-white population did not exceed the state average in either municipality. In New Bedford, the number of non-white population is 12.2%. Low birth weight and cancer rates are at or above state average.